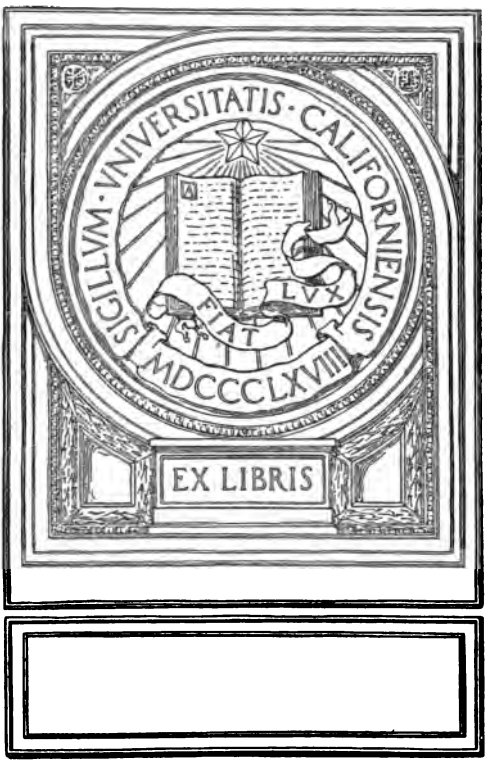
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THOMAS ALVA EDISON—1922

Martin, Tho. C.

Forty Years

of Edison Service

1882-1922

Outlining the growth and development of the Edison System in New York City

Press of
The New York Edison Company
1922

The Marchbanks Press, New York

OUR AUTHOR

An Appreciation

WE have been very fortunate in securing, for the preparation of this volume, the service of one who has been closely identified with the electrical growth of the past forty years; one who is, of all, best acquainted with the life work of the great inventor; one who has contributed in no small measure to the development of the industry through his untiring effort, the clearness and breadth of his vision and the agency of his gifted pen.

In reviewing the history of these forty years, the purpose has been not to present an engineering or technical review, but rather to record some reminiscences and portray the progress of the period largely from the human standpoint, indicating how—as opportunity has arisen—Edison's earliest achievements have grown, and adapted themselves to the ever-increasing demands of an appreciative public.

The author brings into this volume so much of his enthusiastic admiration for the master mind of our industry and his intimate acquaintance with the subject, that our own part of the undertaking has been of the lightest nature. In this tribute to the great accomplishments of Edison in the Central Station field we add our appreciation and sense of obligation to the writer of this volume—Mr T Commerford Martin.

The New York Edison Company

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Forty Years of Edison Service

1882–1922

CHAPTER I

Invention of the Edison Lamp and Central Station Lighting System

THE historic scene is a gloomy Committee Room of the British House of Commons; the date is May 16, 1879. Under a resolution of March 28, a Select Committee of the House, with the distinguished chairmanship of Dr Lyon Playfair, famous politico-scientist, had met to consider the subject of Lighting by Electricity, and under what conditions public utilities should be authorized to engage in the supply of electric light. Breaking in upon sober evidence directed almost entirely to the arc lamp and its use, vague references had been made to the incandescence of iridium. But there was no mention of an "incandescent lamp." Suddenly the chairman threw out a casual remark about "American statements," and invited the witness on the stand to offer his opinion about rumors current that a young man in the United States, named Edison, had succeeded in "subdividing the electric light." The name of the authority need not be cited here, but his reply is worth quoting, for rather flippantly but tersely it summed up the contemptuous attitude of most authorities in America and Europe alike. "He has never put forward any practical statement in connection with this invention that would induce any scientific man to pay much attention to it."

"So say we all of us," was virtually the verdict in the Select Committee, for neither the actual report nor the "draft report," also given very conscientiously in the "blue book," takes the least notice of, or pays the slightest further attention to, Edison and his incandescent lamp. Nor can they really be blamed. The great Tyndall lecturing in January, 1879, at the Royal Institution, and referring to the

hopelessness of the quest after the subdivision of the electric light, said: "Knowing something of the intricacy of the practical problem, I should certainly prefer seeing it in Edison's hands to having it in mine." A month later, Preece, one of England's great electricians, disposing of the subject before the Royal United Service Institution affirmed flatly: "Hence

PORTRAIT OF CHARLES BATCHELOR
The first photograph ever taken by incandescent electric lamps

the subdivision of the light is an absolute ignis fatuus." And did not a book issued in London that year say that they who, like Edison, talked of "indefinitely subdividing" the electric current, did not know, or forgot "that such a statement is incompatible with the well-proven law of the conservation of energy."

Now this book is not the story of the incandescent lamp. That is another Iliad. This is the story of the central station system of electric light and power that Edison built around the lamp as its vital core. Let it be here noted, however, in

passing that Edison had begun his experiments on incandescent lighting as far back as September, 1877, and had had his fertile mind at work on the subject earlier in that year. Arc lighting, then attracting general attention, never interested him greatly. He did not attempt to do any inventing in that field except perhaps to show that it was within easy reach of his genius, although not of immediate interest. With sagacity unique but quite characteristic, he penetrated at once to the root of the matter. While all the inventive talent of the time devoted to electric lighting was absorbed with the merits of the arc lamp, Edison was convinced by his intense study of the business of illumination that the great field to occupy was that in which gas had already been profitable and useful. Indeed, one of the witnesses before the British Committee poohpoohed the electrical rivalry. "Why worry?" he said in later day slang phrase. The street lighting touched by the arc lamp was only 10 per cent of their great output in London. The company had an annual increase of at least 8 per cent, so that the gain of just one year would wipe out such trivial competition. True, indeed, but that alert young man at Menlo Park, New Jersey, was after the 90 per cent. On that he concentrated his tremendous energy, his indomitable courage, his genius as an inventor, his skill as an electrical engineer, his ability as a mechanic, his physical resources as great as the mental, and all the financial support that prior success with the quadruplex telegraph, the stock ticker, the telephone and the marvelous phonograph had placed very freely at his disposal.

Had Edison merely invented the incandescent lamp, this story of the New York Edison system could not have been written. A still popular misconception of his real work stops at the lamp, which is about as near the truth as would be an assertion that the Welsbach burner is the whole of gas lighting. Edison really invented a new art, and his worthy title of "the father of domestic electric lighting" is predicated on a

gigantic group of new ideas and inventions, of which the incandescent lamp was but the central element. Moreover, long before the successful activities at Menlo Park, there had been various brilliant efforts to produce a practical lamp, many experiments, many half-way successes, numerous prophetic approaches; but the entire field of invention is full of that. Even when his American optimism and buoyant enthusiasm, led caustic critics to speak of his "feverish method of research accompanied by propaganda," there were some notable creators who themselves were stimulated to real achievement by Edison's evident unshaken conviction that he was on the right path to the goal. What is here briefly narrated in a few words may be seen illustrated graphically in the magnificent Hammer collection of incandescent lamps preserved in the United Engineering Building in New York City, which sums up all that has been done by the light-bringers in their struggle to obey the great command "Let there be light!"

OLD EDISON LAMP IN SERVICE FOR TWENTY YEARS

The award to Mr Edison, as its fourth recipient, of the John Fritz gold medal, in 1908, sets forth specifically that he had won this blue ribbon of the engineering arts from the four American national engineering societies, not only for better-known gifts to mankind, including the lamp, but for "the de-

velopment of a complete system of electric lighting, including dynamos, regulating devices, and meters." The use of the word "system" in this generously "large order" is significant. Perhaps a noble word was never more grossly abused than was this in the pioneer days of electric lighting—the period of the late seventies midway into the eighth decade of the nineteenth century. Just as in this automobile age a new "car" is often a mere readjustment of unrelated parts to a trivial improvement in engine or gear, so forty years ago electric lighting "systems," spawning in reckless profusion, were usually based on some minor changes in the arc lamp or the dynamo—leading one observer to remark on the exhibits at the first American Electrical Exposition at Philadelphia, in 1884, that according to his investigations, dynamos could be painted any color you chose without increasing their efficiency. Thanks to the great inventions of Brush, Weston, Thomson, Hochhausen, Sperry and others, the American arc lighting industry was founded and it soon dominated the world; but the imitators and plagiarizers and infringers were legion, possibly because it was at bottom an easy, simple art to break into. Once described as "shoe string business," in reference to the flimsy overhead circuits, the new arc lighting companies cluttered up the stock exchanges with their securities, and the work shops with casual jobs making and repairing their machinery. It was a "halcyon time" while the boom lasted. At one period, the *Electrical World* carried the advertising of nearly fifty arc lighting "systems."

Today the only one of all those electric lighting systems, arc or incandescent, of forty years ago, that survives, with every probability of permanency, is the Edison system.

For such a complete disappearance as that it is hard to find a parallel in the arts and mechanics. Horseshoes are still in great demand. Sailing ships still dot the seas. Armor in warfare is still a panoply. But the prosperous arc lighting enter-

prises whose supremacy Edison challenged with his demonstration of the better way, have as utterly vanished from the scene as the dinosaur and the dodo. Economically, they soon

EDISON IN 1881

began to fade away. Financially, they gave an entertainment like that furnished by Aaron's rod before Pharaoh. Electrically, the arc lamp remains a most useful and desirable appliance for a limited range of work, but no longer is a great American industry based on it.

We can but recognize the overpowering prescience of the Master Mind that at the very outset, when all the temptations and indications lay the other way, and when difficulties loomed up large, elected the incandescent lamp as its ideal and proceeded calmly to create around it a "system" which, like the lamp itself throughout an era of revolutionary electrical discoveries and spectacular advances, remains absolutely the same in every basic principle and all its fundamental fitness for public utility service as at the day of its birth.

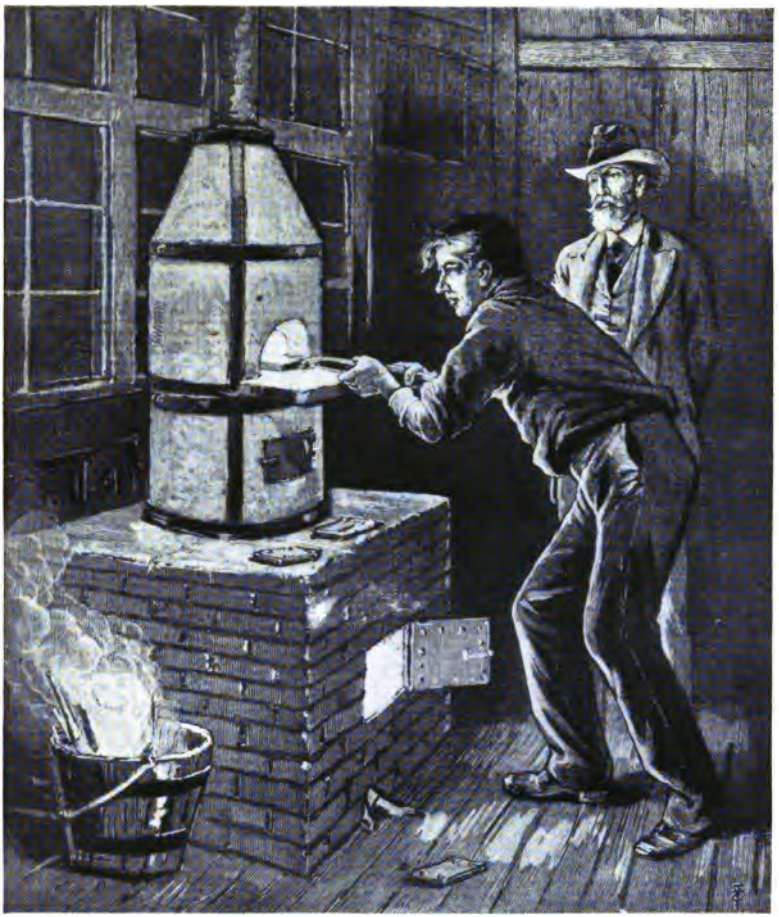
One further connotation is here in place, before passing on to a brief study of the Edison lighting system. Luther Stieringer, a famous gas engineer and expert of the last generation, once said emphatically that Edison knew more about gas than any other man he ever met. If the philosophic epigram is true that genius is largely the ability to recognize essential likeness between things, it must be regarded as another merit of Edison that having determined to see whether "I could subdivide the electric light so it could be got in small units like gas," he at once became an humble student in the school of that illuminant. According to a *Punch* joke of the time, one great triumph of a certain English statesman was due to the fact that he caught the Whigs in bathing and stole their clothes. So, now, Edison was squarely set to avail himself of all the skill and experience of an art that had been developing its best methods of service for over fifty years. Some time, in 1878, he said: "I started my usual course of collecting every kind of data about gas; bought all the transactions of the gas engineering societies, etc, all the back volumes of gas journals. Having obtained all the data and investigated gas-jet distribution in New York by actual observations, I made up my mind that the problem of the subdivision of the electric current could be solved and made commercial."

Nothing in a military survey by a War Staff or College was ever more scientific—or less sensational. Edison, since he

EDISON IN HIS WORKSHOP—1879
Drawn by H Muhrman. *Harper's Weekly*

began inventing, in 1869, has recorded his reflections, studies and experiments in a long file of note books, running into over a thousand in the latest series. Book 184 brims over with references to gas, spaced across two or three years of this momentous period. One pregnant item goes to the very point here being made: "Object, Edison to effect exact imitation of all done by gas, so as to replace lighting by gas, by lighting by electricity." For wise forecast, what can excel the prophecy in the little book, that "gas will be manufactured less for lighting as the result of electrical competition and more for heating, etc, thus enlarging its market and increasing its income." Then a swift glance at the coming age of electric light and power from a common source. "It doesn't matter if electricity is used for light or for power"; while small motors, it is urged "can be used night or day and small steam engines are inconvenient"—with the profound corollary: "Generally poorest district for light, best for power, thus evening up whole city—note the effect of this on investment."

Gas and its able engineers thus found an apt pupil in this young student of whom a co-worker has remarked: "He can travel along a well-used road and still find virgin soil." Mastering the whole technique of an industry in which by 1879, a total of $1,500,000,000 had been invested, he had soon reached his first objective as he thus summed it up: "Edison's great effort—not to make a large light or a blinding light, but a small light having the mildness of gas." Thus far advanced, he may now be left to tell his own story as to the complete Edison system of central station lighting that had been worked out, with equal strides, and passionate persistence that brooked no denial, at the Menlo Park, New Jersey, Laboratory. Of this feat the great leader of the German electrical industry, Emil Rathenau, said on the celebration of his seventieth birthday, that it was "beautifully conceived down to the very details and as thoroughly worked out as if it had been tested for decades in several



NEW JERSEY—THE WIZARD OF ELECTRICITY

Thomas A Edison experimenting with carbonized paper for his system of Electric Light, at his laboratory, Menlo Park

Leslie's Weekly, 1880

towns. * * * All showed signs of astonishing skill and incomparable genius." Said Mr Edison long ago in a terse summary, upon which it would be idle to attempt any improvement:

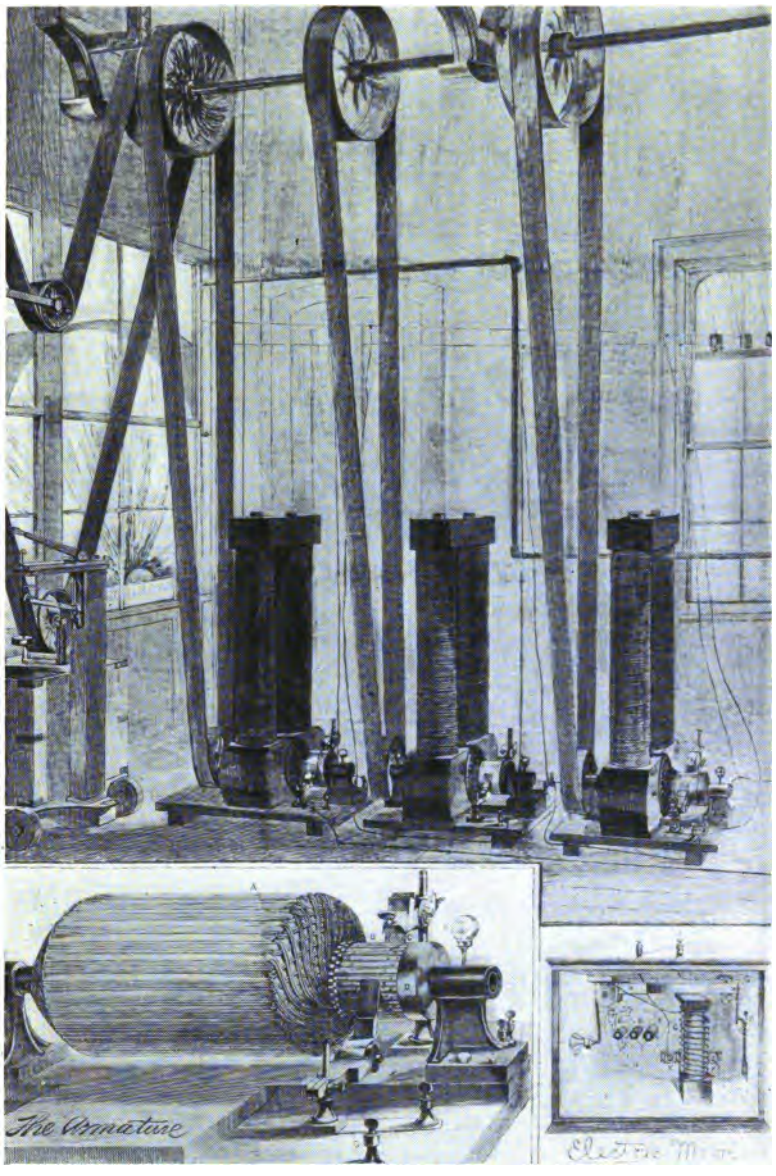
"A complete system of distribution for electricity had to be evolved, and as I had to compete with the gas system this must be commercially efficient and economical, and the network of conductors must be capable of being fed from many different points. A commercially sound network of distribution had to permit of being placed under or above ground, and must be accessible at all points and be capable of being tapped anywhere.

"I had to devise a system of metering electricity in the same way as gas was metered, so that I could measure the amount of electricity used by each consumer. These meters must be accurate so that we could charge correctly for the current used, and also they must be cheap to make and easy to read and keep in working order.

"Means and ways had also to be devised for maintaining an even voltage everywhere on the system. The lamps nearest the dynamo had to receive the same current as the lamps farthest away. The burning out or breaking of lamps must not affect those remaining in the circuit, and means had to be provided to prevent violent fluctuations of current.

"One of the largest problems of all was that I had to build dynamos more efficient and larger than any then made. Many electrical people stated that the *internal* resistance of the armature should be equal to the external resistance; but I made up my mind that I wanted to sell all the electricity I made and not waste half in the machine, so I made my internal resistance small and got out 90 per cent of saleable energy.

"Over and above all these things, many other devices had to be invented and perfected, such as devices to prevent excessive currents, proper switching gear, lamp holders, chandeliers, and all manner of details that were necessary to make a complete system of electric lighting that could com-



EDISON'S ELECTRIC LIGHT—THE GENERATOR
From sketches by Theo R Davis. *Harper's Weekly*, 1880

pete successfully with the gas system. Such was the work to be done in the early part of 1878. The task was enormous but we put our shoulders to the wheel, and in a year and a half we had a system of electric lighting that was a success. During this period, I had upwards of one hundred energetic men working hard on all details.

"One question concerning this early system has often been asked, namely: 'Why did I fix 110 volts as a standard pressure for the carbon filament lamp?' The answer to this is that I based my judgment on the best I thought we could do in the matter of reducing the cost of copper and the difficulties we had in making filaments stable at high voltages. I thought that 110 volts would be sufficient to insure the commercial introduction of the system, and 110 volts is still the standard."

In his presidential address before the Edison Pioneers on Mr Edison's seventy-third birthday, February 11, 1920, Mr John W Lieb, vice-president of The New York Edison Company, quoted the epitome of principles applied to the new art as "forming the foundation of one of the most wonderful industrial developments the world has ever seen." As Mr Lieb pointed out, the keystone of it all was Edison's early intuitive recognition of the "multiple arc" principle, as opposed to the "series" method in which arc lamps, motors or other appliances were connected in series "like beads on a string, and therefore not independent of one another, but all dependent on the integrity and continuity of the circuit or string." The same series method was tried again in electric railway work, and failed once more with disastrous results. There too it is now all "multiple arc." To quote Mr Lieb further:

"At the outset, Mr Edison proceeded on *different* lines, providing for absolute independence not only of the individual lamp but of almost every other element of the system, from the boiler in the station to the interior wiring on the consumer's premises; and whether the apparatus be me-

THE PEARL STREET DISTRICT—"UNDER THE TOWERS"
From the water-color painting by F Hopkinson Smith. *Harper's Weekly*, 1882

chanical, protecting it by stop-valves, ring steam mains, by-passes or by apparatus in duplicate, or electrical, by providing alternate paths and parallel supply circuits, all constructively connected like the rungs of a ladder. In other words, the system was not dependent for its operation on any single one of its elements, every feature was practically in duplicate, and means were provided so that any defective section could be instantly segregated and eliminated, where practicable, automatically.

"This principle of operating everything in 'multiple arc,' a simple and efficient method of securing duplication of every important working part, is absolutely essential to regularity and continuity of electric service of the highest standard, and this has always been a conspicuous outstanding feature of the Edison system and the corner-stone of its commercial success.

"The art of building dynamo-electric machines was at this time in a very embryonic state. Electricians at the time regarded the dynamo as the equivalent of a primary battery and they considered that like the battery, to obtain the maximum amount of work from a dynamo, its internal resistance must be equal to the resistance of the external circuit. Edison recognized that to obtain the highest efficiency from the dynamo he must reduce the internal resistance as much as possible, and expend a maximum amount of energy in useful work in the external circuit. Hence his efforts to produce a dynamo of low internal resistance and the greatest possible elimination of hysteresis and core losses by laminating, japanning and separating with paper the iron core discs.

"The early Edison dynamo had many admirable features of design, particularly in the details of armature-core construction, although the brush holders and rocker arms were excessively crude. Mica insulation was first used for commutator insulation on the 'Jumbo' machines."

The presentation of the Edison central station system at the time it became the foundation of the fortunes of The Edison Electric Illuminating Company of New York, would be far from complete without further reference to the Edison

dynamo. Edison's new theories ran counter to the tenets of all the textbooks on dynamo-electric machinery, but once again his diagnosis reached the heart of the matter. It might be asserted that here Edison was even more at home than he was with his own still unfamiliar lamp, for his knowledge of electrical energy and its flow in circuits, as well as his acquaintance with the properties of magnets, was derived from years of practical work in other fields. No man in America knew more than did he about the characteristics of electromagnets. One of the reasons why so many of the great leaders in the later electrical arts came easily to the front was that as telegraphers they too had sucked in, like mother's milk, a bosom understanding of batteries, magnets, iron and copper wire, insulation, and scores of phenomena that no other set of men could so well apply, broadening out ancient precedent to new conditions with a skillful craftsmanship that was second nature.

If it be thought that the partiality of friendship leads here to an over-kindly laudation of what Edison did with his new dynamo, note may be made of a significant controversy that adorned the classic pages of the *Scientific American* in November, 1879, when he was once more vigorously assailed for attempting the impossible, and a warning finger was shaken at him, for: "His reputation as a scientist, indeed, is smirched by the newspaper exaggerations, and no doubt he will be more careful in future."

One is tempted in a field so fruitful of incident and anecdote to linger on these early episodes of inventing and announcing the Edison lighting system. But, the stage is set and the curtain must now ring up on the introduction to the inhabitants of New York City not only, but to the world at large, forty years ago, of the now universal system of electrical energy supply and distribution and its application to every purpose of which the mind of man could conceive.

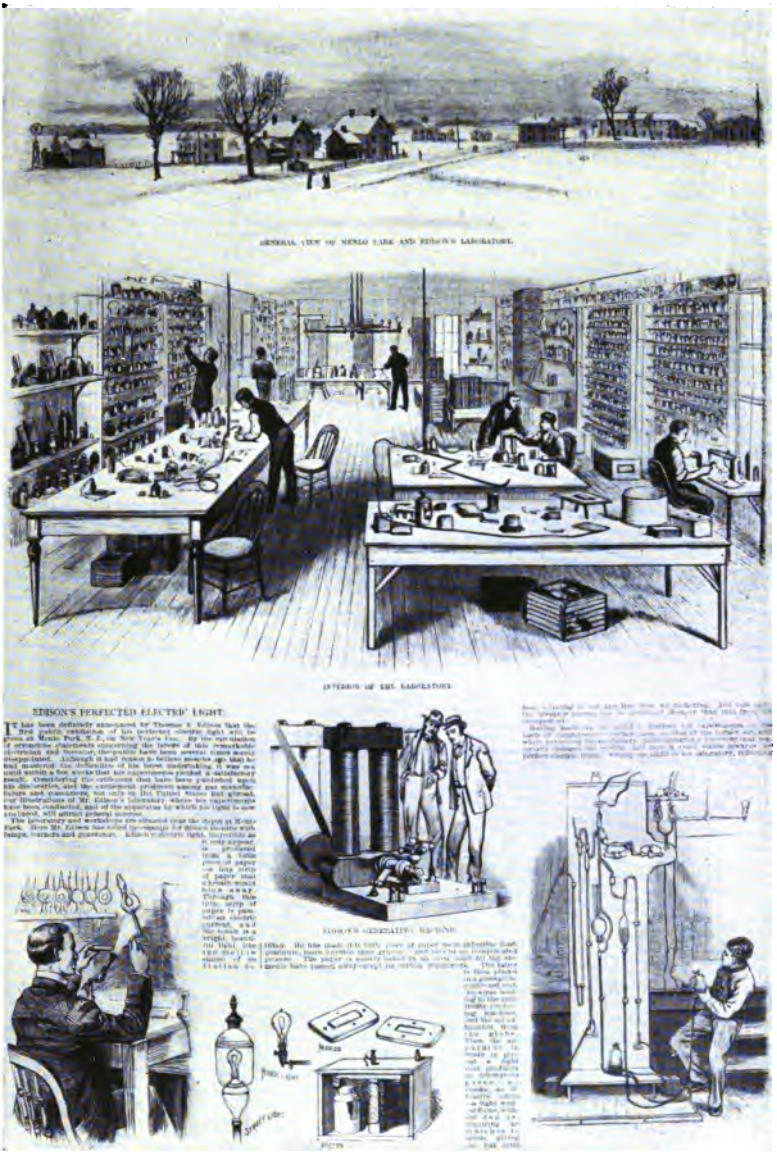
CHAPTER II

Early Demonstrations of the Edison System

BY the Edison lamp, the very word "illumination" was brought back to its pristine meaning, of something decorative as well as useful. And now the lamp, associated with the Edison system and dynamo, was to be with the telephone and the electric motor, one of the trinity of great exponents of the transcendent merits of the modern idea in furnishing the public through a central source with light, heat and power, communication and transportation.

Away from perpetual lamps that must never be allowed to go out on penalty of death, away from torches and tallow candles, away from whale oil and tinder box, Edison had thus carried the art of illumination to its New World, as virgin for coming endeavor and benefaction as that low shore where on the eve of another October night, four centuries earlier, eyes of wave-worn sailors straining into the western darkness saw the gleam of a flickering light, and were instantly at the end of their long quest led by another immortal discoverer.

Said Judge Colt, in 1894, in one of the first opinions validating the patents protecting the Edison lamp. "He produced the first practical incandescent lamp; the patent is a pioneer in the sense of the patent law; it may be said that his invention created the art of incandescent electric lighting." During the critical, crucial years of 1879-80, '81 and '82, a literal volcano of invention throwing off great chunks of mother earth and streams of fertilizing lava, Edison was granted in America alone over 225 patents on lamps, dynamos and his system of distribution or its details. Yet even that evidence of preoccupation cannot mask the grim fact that during the same period he took out as many more patents on inventions as widely apart as preserving fruit and



NEW JERSEY—THE WIZARD OF ELECTRICITY

Thomas A Edison's System of Electric Illumination

Leslie's Weekly, 1880

embalming human speech; and as opposite as telephones and magnetic ore crushers. It was a joy, yet almost suicide, to work shoulder to shoulder with such an encyclopædic genius, who once wished he had been born on Mars because there the days are forty minutes longer. The young man who kept the path to the Patent Office hot with his footsteps, urged his co-workers on, when they reported apparent failure, to persevere, to find causes, with injunctions such as this: "Well, fool with it till you do." One thing above all others he now yearned for, and that was to break from the cover of his laboratory and demonstrate to the world that he could make good on all his promises and also justify the optimistic utterances of even such dithyrambic supporters as Edward H Johnson. Never noted for understatement, yet always marvelously in advance of his times, Johnson had had flung at him in England the jest: "There is but one Edison and Johnson is his Prophet"; while on his native heath, his jubilant pronouncements were greeted with the sneering taunt of "sounding his barbaric yawp over the rooftrees of the world."

On December 21, 1879, the New York *Herald* gave a jolt to the imagination of its readers on Manhattan Island by devoting a whole page to the Edison lamp and system of electric lighting. This enterprising publicity was done off its own bat, and it so excited the public that Edison, though embarrassed, was grateful and decided to make his first exhibition. This was done on New Year's eve, 1879-80, when special trains were run out to Menlo Park by the Pennsylvania Railroad, and over 3000 persons, including many public officials, prominent citizens, scientists and capitalists went to see for themselves. It is unhappily to be recorded that all were not well-wishers. A personal memorandum by Mr Edison in the hands of the writer says: "In the early days of my electric light, curiosity and interest brought a good many people to Menlo Park to see it. Some of them did not come

with the best of intentions. I remember the visit of one expert, a well-known electrician, graduate of Johns Hopkins University. We had the lamps exhibited in a large room, and so arranged on a table as to illustrate the regular layout of circuits for houses and streets. Sixty of the men employed at the laboratory were used as watchers, each to keep an eye on a certain section of the exhibit, and see there was no monkeying with it. This man had a length of insulated No 10 wire around his sleeve and back, so that his hands would conceal the ends, and no one would know he had it. His idea, of course, was to put this across the ends of the supplying circuits and short-circuit the whole thing—put it all out of business without being detected. Then he could report how easily the electric light went out and a false impression would be conveyed to the public. He did not know that we had already worked out the safety fuse, and that every little group of lights was protected independently. He slyly put this jumper in contact with the wires—and just four lamps went out on the section he tampered with. The watchers saw him do it, however, and got hold of him, and just led him out of the place with language that made the recording angels jump to their typewriters."

It was through all this period that intensive work went into the Edison dynamo, whose relatively large masses of iron were in sharp contrast to the other machines of the day. Francis Upton was doing splendid work on magnetism that might well have been brought into literature as was that of Hopkinson and Kapp, feeling out as he did novel magnetic curves that showed where saturation had begun and when it was useless to spend more energy in "building up the field." Thus Edison with the famous Gramme ring dynamo as his point of departure soon perfected his own generator for the "system"; and whereas an efficiency of 40 per cent had been regarded before as within reach he jumped it to twice that figure; so that after John Kruesi had finished the first

practical dynamo, and after Upton had tested it thoroughly and verified his figures and results several times—for he, too, was surprised—Edison was able to tell the world that he had made a generator giving an efficiency of 90 per cent.

Swift was the rush of invention, though slow often its official registration and recognition. Thus in the very midst of the experiments and researches, the first Edison application for a patent on his "System of Electrical Distribution," was signed January 28, 1880, but it was not until August 30, 1887, that the Patent Office issued to him the "bedrock" Patent No 369280—five years after The Edison Electric Illuminating Company of New York had had it in commercial operation. Of it the *Electrical Review* remarked at that time: "It would seem as if the entire field of multiple distribution were now in the hands of the owners of this patent —about as broad as a patent can be, being regardless of specific devices, and laying a powerful grasp on the fundamental idea of multiple distribution from a number of generators throughout a metallic circuit." Indeed 1880 bristled with this kind of performance, notably the patent on the famous "Feeder" invention to which fundamentally the dwellers on Manhattan Island owe the beautiful steadiness of their incandescent lamps, its object, successfully achieved, being to obviate any "drop" in pressure, that would otherwise render the lights dim at points of heavy demand or at points remote from the generating central station. There was an enormous saving in copper used in the circuits thus laid out; but the engineering and commercial economy effected was carried a gigantic step further when Edison passed from this simpler two-wire system to the now universal three-wire. Compared with what went before the Edison three-wire patent, which was granted just as the New York system was getting into its stride, in 1883, effected a saving of no less than 62½ per cent in the amount of copper required.

THE ELECTRIC LIGHT IN HOUSES

Laying the tubes for wires in the streets of New York
Drawn by W P Snyder, *Harper's Weekly*, 1882

All this was, at the time, going on behind the scenes. Out in front the audience was clamoring for the show, with impatient applause mingled with derisive hoots. The "ragging" was indeed very fine, and breezy "Ed" Johnson, stage manager, longed to run the curtain up, for he knew they had a spectacle that would "bring down" the house. It had indeed reached the moment when the "parent" Edison Electric Light Company, formed in 1878, must produce proof or shut up the little Edison manufacturing shops struggling for precarious existence as they brought out the lamps, the dynamos and the various parts of the "system." Be it remembered that outside the bare copper, the iron, steel or sheet brass, Edison had literally to build with his own hands all that bore his name. Though some of the backers may have wavered a bit as the demands for money grew in the experimental stages, Edison had loyal financial adherents. They could but emulate the courage of one who then as later gave evidence of the faith that was in him by throwing all he had into the melting pot.

Hence it came about, in a rather curious way, that the rehearsals for the Edison system to be the first established as a public utility in New York took place in Europe. Interest there in what Edison was doing became as keen as in America, and skepticism was giving way to enthusiastic admiration, especially in England, France, Germany and Italy, associated with a keen desire to get in on the "ground floor," although the capitalists would hardly have expressed it that way. Mr E H Johnson, who had already broken ground for Edison in England with earlier inventions, was straining at the leash to sail over again with some "brighter and better" and assuredly "bigger thing" with which to astonish the Britishers, between whom and himself a real affection ever existed. Paris, "La Ville Lumière," was appropriately the spot where Edison made his first foreign display. For the first electrical exhibition ever held he shipped to Paris, early in 1881, the

EDISON'S FIRST DISTRICT

The tall buildings which now cast their shadows over the district where Edison Service had its beginning. Etching by E Horter

largest dynamo constructed up to that year. It weighed with its driving engine 27 tons, and the armature weighed 6 tons. It was capable of energizing no fewer than 1000 of the Edison standard lamps of that day. The New York Edison Company now has dynamos each of which will maintain 700,000 lamps of three times the candle power. But that direct-connected Edison machine of the time was veritably an eighth wonder of the scientific world, studied admiringly by the savants of Europe. Mr Charles Batchelor, the Englishman who had long worked side by side with Edison, and whose steady hand despite nervous excitement had carried the first Edison carbon lamp—was the French representative. He was soon busy organizing the French Edison corporation, and gathered in for his chief at home Mr Nikola Tesla, who later was to reap in America the fruits of his long study of the alternating current which was to receive its first extensive application in the great electrical transmission and utilization of the energy of Niagara. Mr Johnson, following close on Batchelor's heels was sent to London, to demonstrate the new lighting system practically and to make an exhibit at the Crystal Palace Electrical Exposition of 1881-2. Not only did he accomplish triumphantly his specific mission, but to reinforce the staff at Menlo Park he persuaded to go over to Edison as his private secretary Mr Samuel Insull, whose personal relations with the inventor and whose later distinguished leadership of the central station utilities of the country is one of the most notable chapters of modern American development. Called to his new work by cable Mr Insull arrived in New York on March 1, 1881, in time to take an active part in the preliminaries connected with the organization of the various Edison manufacturing enterprises, and to be the indispensable link between the "Laboratory,"—the Edison Electric Light Company at famous old "Sixty-five Fifth Avenue," for many memorable years the home and hearthstone of the Edison lighting system,—and all who had to do with its intro-

duction. Incidentally it must be here recorded that the man selected to carry knowledge of the technique of the Edison central station system into Italy, in the latter part of 1882, was Mr John W Lieb, an early Edison worker, and now vice-president of The New York Edison Company.

Nicknamed after a then popular elephant, Edison's No 1 "Jumbo" Dynamo had gone to Paris. The second and third were installed in London by Johnson, who, assisted by his engineer, W J Hammer, an early Edison worker, inaugurated on January 12, 1882, a 3000-light exhibition plant on the Holborn Viaduct. It is quite a common practice in the theatrical world to "try out" a play quietly "in the provinces" before putting on the boards of Broadway; and in this instance London's position was reversed. Edison had had as a matter of history his first actual central electric lighting station supplying lamps and a motor or two at old Menlo Park. It was fed by means of underground conductors imbedded in asphaltum and surrounded by a wooden casing, all worked out by John Kruesi, who afterwards patented his inventions predicated on Edison's specifications for the work. Now, in London, something of the same kind was repeated on a much larger scale, foreshadowing not merely as an exhibition, but commercially, that which, with Edison's own handiwork in it and his own seal on it, was to be inaugurated a few months later, on September 4, in New York. It would probably have been the nucleus of a real public utility, but for the passage of the unwise English electric lighting act of 1882, which throttled central station development in the British Isles for many years. The Holborn plant "hooked on" the famous City Temple of Dr Joseph Parker, the first church in the world to be electrically illuminated. Through Sir William H Preece, who had started to scoff two or three years before but now remained to praise, the telegraph operating room of the General Post Office at St Martin's-le-Grand was equipped with 400 lamps; and the

streets and bridges, integral part of the Viaduct, were lighted by lamps controlled from the plant. Mr Johnson in some unpublished biographical data makes a very interesting statement: "At this time tall masts surmounted by a group of high candle power arc lamps were much in vogue in London, and I desired to enter into competition with them by substituting an electric lamp of 32 candle power for the ordinary gas jet on each gas post throughout the length of the Holborn Viaduct. For this permission was granted me by the city, and the work was carried out eliciting an extremely favorable criticism from the press and public generally. This was unquestionably the beginning of the end of group arc lighting, and I think may now be taken as the beginning of the end of the arc light itself." On one other feature, the evolution of fuses and fixtures, Mr Hammer deserves to be quoted as follows: "Up to the time of the construction of this plant it had been customary to place a single-pole switch on one wire and a safety fuse on the other; and the practice of putting fuses on both sides of a lighting circuit was first used here. Some of the first, if not the very first, of the insulated fixtures were used in this plant, and many of the fixtures were equipped with ball insulating joints, enabling the chandeliers or 'electroliers' to be turned around, as was common with the gas chandeliers. This particular device was invented by Mr John B Verity, whose firm built many of the fixtures for the Edison Company and constructed the notable Edison electroliers shown at the Crystal Palace Exposition of 1882."

So much for history—for the real facts in connection with the early demonstration and instruction of the Edison central station system all leading up to crystallizing and focusing in the Pearl Street Station of the Edison Electric Illuminating Company of New York; a plant which Edison regarded as the true embodiment of his hopes, ideals and inventions in electric lighting, and to which he devoted a loving care and patient thought unsurpassed in any of the other

campaigns through which he had fought to the perfect finish of happy fruition. This chapter may therefore fitly close with a brief statement that sets right some inaccuracies so generally accepted that they are found in the whole range of the voluminous literature devoted to Edison. The assertion has been made that the Edison Plant at Appleton, Wis, was his first central station, started August 15, 1882. The present anniversary in New York caused a natural investigation of dates and data; and it has been a matter of general surprise to discover that Appleton was not actually started until September 30. How the error arose is not quite clear, but it may be conjectured that the confusion of dates started when on August 18, 1882, the young Western Edison Company of Chicago made a contract with the new Appleton, Wis, Edison Light Company to supply and erect two Edison "K" dynamos to be driven by water power and to be capable of supplying 550 lamps. Mr E T Ames, sent to make the installation, gives the date of going into operation as late as October 15, but the local newspapers may be believed when they stated at the time that the first lights "flashed" September 30. The tiny plant was surely a very modest one, with a single dynamo of 180 light capacity of 10 candle power each; and it was housed in a very unpretentious wooden shed, resembling many a rural Ford garage of today. It has the glory, however, of being the first Edison water power station, and the little machine solidly built kept going merrily until its "patent ran out"—seventeen full years—or until 1899, when it gracefully expired with the century. Hundreds of thousands of horsepower are now furnished from the eternal assets of Nature by the "white coal" of water power in the United States alone, saving the fuel supply, through central station companies, many bearing the magic name of Edison, in every hydroelectric State in the Union. Hats off to Appleton!

Chapter III

Formation of the First New York Edison Company

"BEHOLD! I make all things new," is a phrase that may be reverently appropriated to describe the effect of the successive electrical inventions of the last fifty years. More particularly is the influence of the telephone, the arc lamp, the incandescent lamp, the electric motor, the trolley car, the underground roads, the electric elevator, the Edison central station system of distribution, to be seen in the great centers of population. Of all the modern cities New York best exemplifies what electricity can do, for in every branch of electrical utilization it is pre-eminently the largest exponent and patron. Perhaps that is a mere corollary of having the largest number of inhabitants, but Greater New York is the vivid exhibition of the furthest reach of the electrical arts, all save machinery manufacture; but even the largest electrical factories in the world, at Schenectady in the Empire State, are administered from New York, which is equally the center of all American electrical finance.

It was but fitting, if not, indeed, inevitable that Manhattan Island should be the scene of Edison's first real central station experiment as a public utility, just as it was the home of the parent Edison Electric Light Company, and of all the other great enterprises with which his name had been connected since he struggled into town seeking an humble job at the telegrapher's key, but with a head fuller of more great inventions and arts than ever before sprang from one human brain. There have been many creative forces at work to make the splendid metropolis that sits on its magnificent throne-gateway to the New World, but he who went down on his hands and knees in her very dirt to give her the use of electric light and power, from subcellar to the very crest of her tallest

THE WORLD AND TRIBUNE BUILDINGS

Hall of Records at right, Municipal Building construction at the left. Etching by E Horter

towering skyscraper, might well be selected as her modern incarnation, representative to stand alongside the man who put the "Clermont" on her shining Hudson River a hundred years ago.

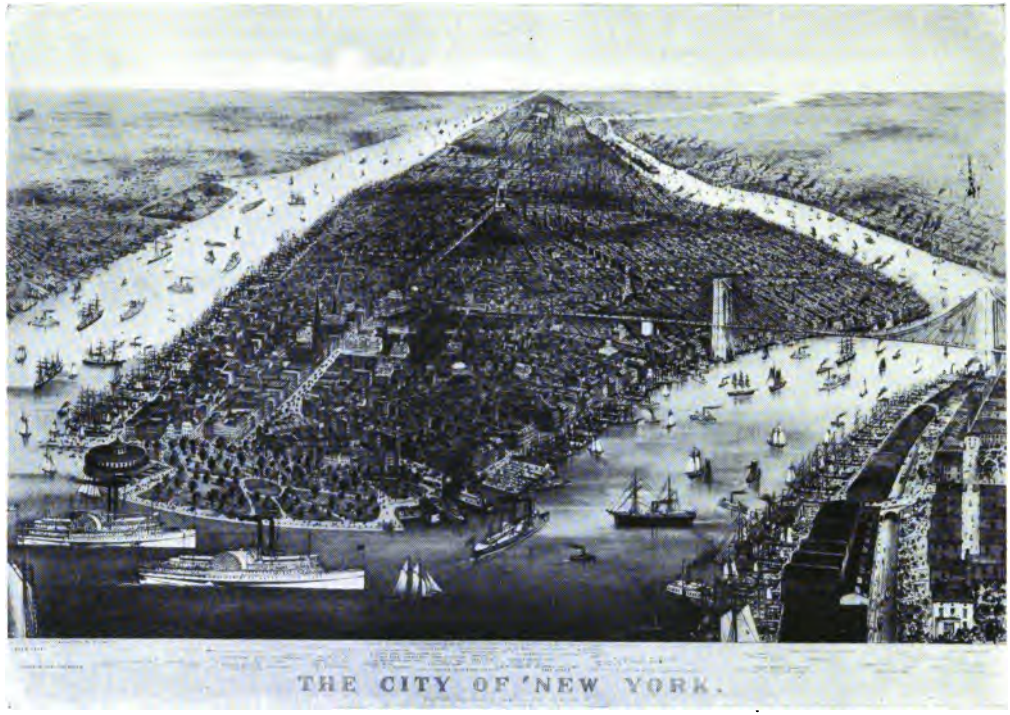
The Edison Electric Illuminating Company of New York was incorporated in 1880 with a million dollars of capital stock by Messrs Tracy R Edson, James H Banker, Robert L Cutting, Jr, Nathan G Miller, Grosvenor P Lowrey (many years Edison's faithful and devoted legal adviser), and E P Fabbri and J F Navarro, of Drexel, Morgan & Company. From first to last John Pierpont Morgan was an admiring friend and stalwart fiduciary supporter. The first meeting of the new company for the election of officers was held December 20, when in addition to Messrs Fabbri, Edson, Cutting and Miller there were also present as directors Messrs S B Eaton, Henry Villard, R M Galloway and James O Green. At this time Dr Norvin Green, later president of the Western Union Telegraph Company, was elected president, Mr Fabbri, treasurer, and Mr Calvin Goddard, secretary. On March 23, 1881, Major Eaton, vice-president of the parent Edison Lighting Company, was also made vice-president of the Illuminating Company; but curiously it was not until December 16, a year after organizing, that Mr Edison was appointed "engineer" to the Company. One of the many features of policy elaborated and adhered to by Edison in launching his central station system, was the issuance by the parent company holding his patents of a license to each new local company wherever operating, for the exclusive use of the system in the specified territory; and this license embraced also isolated plants that might be called for within the territory. The license was granted in consideration of a certain sum of money and a fixed percentage of the capital stock of the subcompany; so that Edison thus elected to stand or fall by the operating success of the licensees intermediary between himself and the public.

Then came the selection of a site for the station in New York and the purchase of the property for the plant in what was to be known as the First District. The area thus to be served was about a sixth of a square mile, bounded by Wall, Spruce, Ferry and Nassau Streets and the East River. Of course, an ideal location of a central station is the very center of the area served, but the topographical center might be undesirable for many reasons; and the end of these four decades in electrical generating and transmission practice, due to radical changes in the art, finds nearly all large central stations governed not even by access to condensing water or ease of coal supply, but often by factors of far wider scope such as relation to water powers in remote mountains and by the production of energy even at the pit's mouth. Fortunately none of these latter complexities had then developed to worry a man whose mind was already fully charged with difficult problems. His own autobiographical notes in the writer's hands tell the story very graphically: "While planning for my first New York Station—Pearl Street—of course, I had no real estate, and from lack of experience had very little knowledge of its cost in New York; so I assumed a rather large liberal amount of it to plan my station on it. It occurred to me one day that before I went too far with my plans I had better find out what real estate was worth. In my original plan I had 200 by 200 feet. I thought that by going down on a slum street near the waterfront I would get some pretty cheap property. So I picked out the worst dilapidated street there was, and found I could only get two buildings each 25 feet front, one 100 feet deep and the other 85 feet deep. I thought about $10,000 each would cover it; but when I got the price I found that they wanted $75,000 for one and $80,000 for the other. Then I was compelled to change my plans and go upward in the air where real estate was cheaper. I cleared out the building entirely and built my station of structural iron work running it up high."

FORMATION OF EDISON COMPANY

It is pathetically amusing to observe Edison hunting for the site he wanted in the "worst dilapidated section" of a "slum street," for old Pearl Street at the beginning of the century had been one of the very aristocratic thoroughfares of old New York, a choice residential quarter for wealthy families, and the haunt of fashion. One more commentary on the "swift, quick shutter effect" that has barely preserved the picture of a new street before it is blended into yet another with the subtle transitions of an Edison motion picture film. Since the average life of even a modern skyscraper is only twenty-five years, there is unfortunately no ground for hoping that in years to come New York may settle down and lose its "covered wagon" habit of moving on nightly—unless we take seriously the recent philosophic observation of Mr Charles A Coffin, the recognized leader of the Electrical Manufacturing Industry, who, looking back on forty years of gigantic electrical manufacturing, remarked on electricity's powers: "Heretofore we have been compelling it to take us to the city, and it has done so beautifully, more quickly and comfortably than we have ever been moved before. Hereafter we shall simply touch a button and have it take the city out to us."

Far from speculating as to what protean electricity was going to do later in the disintegration of American cities, the board of directors of the first Edison Lighting Company had to bend all their thoughts and energies to securing a squalid little corner of Manhattan Island—a backyard dustheap on which Edison could nurture his first tender "plant." Those thus responsible for the construction of this pioneer plant were some already mentioned, to whom were added Messrs J Hornig, C L Clarke, H M Byllesby and others. The property secured by the board was the double building Nos 255-257 Pearl Street, occupying a lot 50 by 100 feet. It was four stories high with a fire wall dividing it into equal parts. One of these parts was converted for the uses of the station



NEW YORK, ABOUT 1880

as a generating plant, and the other half was made into a tube shop as a center for all necessary preliminary underground construction work. At the present time, a central station is designed and built for its specific purpose and use. It has been said that a civilization can be judged by its architecture and the ruins that it leaves, an apothegm that may apply better in the twentieth century than it did in the nineteenth so far as the use of electric light and power is concerned. Forty years ago, no architect had even penciled the outlines of such beautiful buildings as were later put up by The Edison Electric Illuminating Company of New York and its successor, The New York Edison Company. Even the earlier electrical arts had but the fine Western Union building to point to with pride, on lower Broadway. Not only did Edison give light a structural value, but he has furnished the architect with many a new opportunity; and if the future Patagonian perches on the ruins of Brooklyn Bridge in ages to come, edifices most likely to be preserved for his contemplation will be the massive central stations seated strategetically on the banks of the East River. But when that little coterie of directors went slumming for real estate in 1881, any old building was good enough for the power plant. It was usually a converted factory. One in New York was made over from an ancient soap works, another a wall paper factory, and the dynamos standing on greasy plank floors usually delivered their current to a huge wooden switchboard!

While the old Pearl Street Station buildings were being adapted to their new service, the laying of the Edison mains in the First District underground had to be prepared for. A later chapter will deal with that vital part of the New York Edison system. Here it is very necessary to note that in putting his wires underground Edison as in practically all the other features of his system ran counter to experience and prejudice. A great telegrapher earlier than himself, Morse, in introducing the electro-magnetic telegraph had tried first

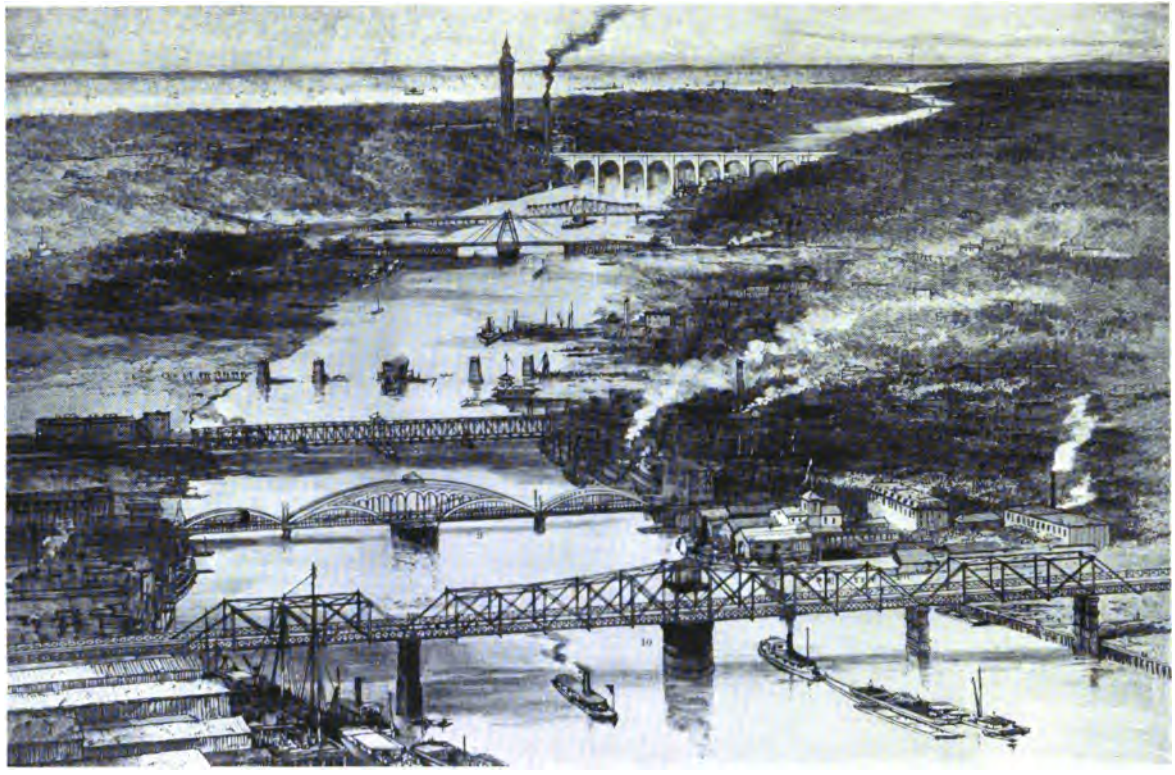
to put his wires in the earth, where atmospheric influences could not disturb them; and the frequent complete stoppages of telegraph service by storms since 1845 have proved Morse's foresight, as he very reluctantly put up the first of the millions of poles and wires that have spoiled the beauty of street and landscape and darkened the very skies. When Edison quite easily got his first permits and franchises to break open the streets, there was no such thing known in the world as the underground system he had in mind; but while it may not have been exactly relevant he had a pet answer to the objectors in his frequent remark: "Why, you don't lift water pipes and gas pipes up on stilts." So slow, indeed, was electrical opinion in coming around to Edison's standpoint, that many years later, a schism over the underground question threatened to wreck the great representative National Electric Light Association, many members fighting for the old order of things. It is also significant that when New York State legislation created the underground system for Manhattan Island the engineer chosen for the Board of Electrical Control was S S Wheeler, who had "learned how" working side by side with Edison on the mains for the First District fed from old Pearl Street.

The capital of The Edison Electric Illuminating Company of New York, merely $1,000,000, soon proved, of course, all too little for its object, but none of it could be applied to this underground work nor indeed to any of the other manufacturing that was necessary to equip the plant. For that the local company had to look to its licensor, the parent Edison Electric Light Company, but the inventor himself dipped deeply into his own resources, and in that way he was virtually helping to finance the local corporation.

The strain of it all, on everybody, in every direction was tremendous. Edison probably never enjoyed himself more in his life—the unperturbed center of the storm. He had become an international celebrity—and his electric light shares

of $100 par value were being quoted at $3,500 per share. But none of those things moved him from the work in hand, pursued in a spirit very far from that with which the critical unbelievers credited him. Says Mr Wheeler, fresh from Columbia College, of this very period: "When I joined the Edison forces, I found that correct application of theory was the preferred method of dealing with each subject; that those who looked at problems from this viewpoint were sought after and appreciated. This different atmosphere which tended to bring about a scientific basis of station operation, awakened all my enthusiasm and made an impression on me that I shall never forget." Another glimpse of an amusing nature is furnished by Mr Lieb. The public had in general been swept off its feet by the startling succession of electrical advances, and as now after the Great War—another crisis in human affairs—the air was full of talk of spiritualism, hypnotism, auto-suggestion, mesmerism and magnetism's effect on the body. The colossal fields of the Jumbos—the largest electromagnets that had ever been constructed—afforded an excellent opportunity for a test. So Mr Lieb, the first electrician of old Pearl Street, saw a chance to test the current psycho-physiological theories: "When the armature was removed, the big cylindrical gap that was left gave plenty of room to accommodate a mattress as a bed. To make a trial, I slept all night in 'the air gap' with the field fully excited. On waking after a nap of four or five hours—for that was all the sleep anyone ever got in those trying days—my sensations were not unusual; neither was my 'big-head' feeling changed, for it was a sort of a chronic state with most of us at the time." Some years later the famous English electrical engineer, Dr Sylvanus P Thompson, repeated the experiment in London—again without the slightest cerebral or nervous effect.

Other reminiscences of the pre-operation period at Pearl Street will fit better perhaps into the coming chapter. A pause



BRIDGES OVER HARLEM RIVER
Harper's Weekly, 1882

may be made here to contemplate with quiet amazement the extraordinary spectacle that centered around the group of men associated with the young enterprise. No industry follows more closely than the electrical the fluctuations of life in the great modern city, the ebb and flow of its human torrents of travel, the daily rise and fall of commercial activity, the booms and breaks in manufacturing intensity; the seasonable exigencies of the calendar; the enwrapping habits that fit the average citizen tighter than his clothes, the changes in fashion, and the shifts of population en masse into new areas of occupancy. Yet this little bunch of pioneers and the weird genius at their head were jauntily taking on a proposition that in sheer boldness had stood unequalled since Joshua thrust his sword up into the solar system. Thus spake the gallant son of Nun as he waged Hunnish war on the Amorities: "Sun, stand thou still upon Gibeon, and thou, Moon, in the valley of Aijalon," and, according to the veracious chronicler, it so happened. Now Edison and his Pearl Street tribe undertook in a more modern way to go Joshua one better. A great American philosopher, not foreseeing the advent of automobiles, recommended the youth of the country to hitch their carts to nothing smaller than an asteroid. With Joshua and Emerson, the points of view were purely personal and local, regardless of trouble caused everybody else beyond the mere scene. Edison swinging out into space with plans immeasurable and scope illimitable put electric light and power supply in multiple arc with the Ages. Clocks and calendars and precessions of the Equinoxes, all are purely incidental to the conception and execution of a central station system that runs smoothly with ceaseless beat and rythmic hum every second of time, and whose dependability is superior even to that of the great orb of day—at least in the murky meridian of old Manhattan.

Why, of course, no other ideal could be adequate for light and power supply! Most other modern services, utilities and

conveniences are subject to interruptions that are accepted with a degree of patience or despair that is to be rated by the individual reaction. "Line busy," "Train late," "Wires down" and all kinds of such "rain checks" beset the great public utilities upon which intercourse and happiness so much depend. But it is splendid testimony to the manner in which Edison's noble confidence in the supreme ability of his inventions to do all and be all that is expressed in "Readiness to Serve," that even a faint, fluttering flicker in the lamp at desk, machine or bedside, anywhere throughout the length and breadth of New York, should it ever occur or attract attention, is but for an instant noted, and then the unheeding world wags on.

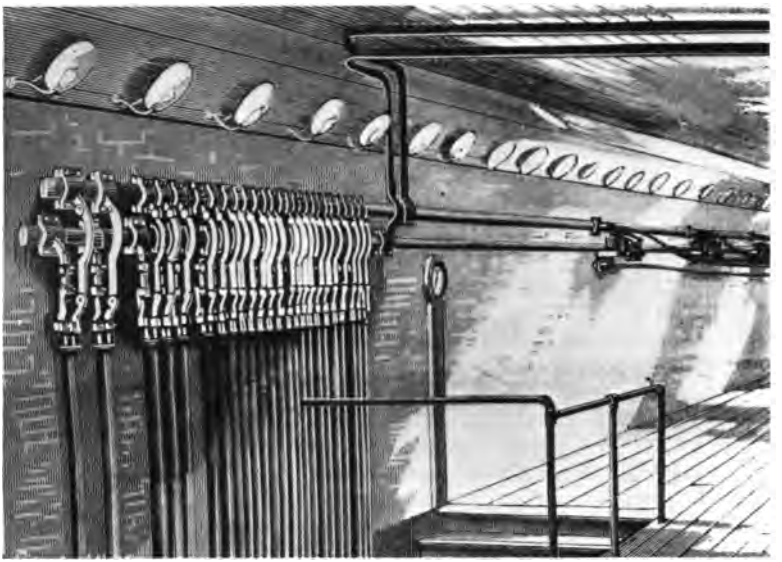
CHAPTER IV

The First Edison Central Station—Pearl Street, New York

"WHEN we put down the tubes in the lower part of New York, in the streets, we kept a big stock of them in the cellar of the Station at Pearl Street. As I was on all the time, I would take a nap of an hour or so in the day time—any time—and I used to sleep on those tubes in the cellar. I had two Germans who were testing there, and both of them died of diphtheria caught in the cellar, which was cold and damp. It never affected me," said Edison.

The Germans doubtless took their regular sleep. Edison didn't, and hence escaped, although his intensely robust vitality and resistance to fatigue account for the freedom from disease he has enjoyed all his life. At any rate, just then, with Pearl Street going into operation, it is certain that he never retired to his luxurious cellar couch until he could no longer stand up in the trenches. There was a small bedroom on the third floor of the station, but Edison was too busy to seek it. For all the men around Pearl Street, a shave and a clean shirt were rare enjoyments until the plant went into operation—and even then the days of feverish activity and ceaseless anxiety were by no means over at once, nor for many months thereafter.

The story of old Pearl Street bristles with many human and personal incidents, a few of which will be set down here as corroborative detail; but a glance must first be taken at the plant. It was very small,—judged by any modern scale of electrical development,—but after all, the "*Santa Maria*" had to come before the "*Majestic*" and the smaller of the two was infinitely larger than the latest "greyhound of the seas" in essential significance. In the case of Pearl Street, some of its



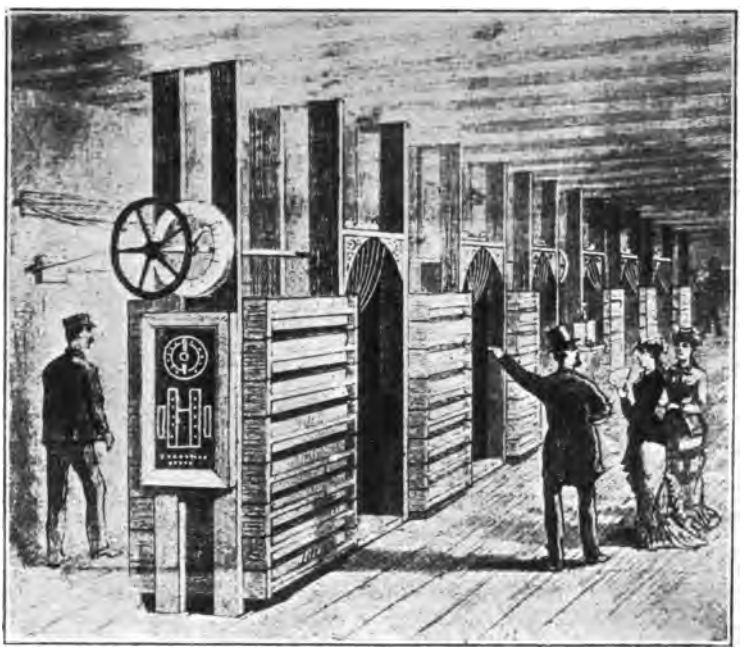
STREET CONNECTIONS AT OLD PEARL STREET

material was actually built into later stations. For example, girders meant for 257 Pearl Street went into the construction of the succeeding Duane Street plant; while the boilers, after twelve years' service on the old original site, were removed to the Fifty-third Street station, and there again continued in useful operation until May 22, 1902—in all, nearly two decades of hard service.

The steam plant at Pearl Street consisted of four Babcock & Wilcox boilers, rated at 240 horsepower each, with cast iron headers, injectors, and a steam pump with connections to each unit, the water circulating through exhaust heaters at the rear of the building. The vault under the front sidewalk and basement had machinery for coal and ash handling. A 20 horsepower engine, countershafted, drove a screw conveyor that delivered the coal to the furnaces, another screw taking the ashes from the grates and discharging them into a

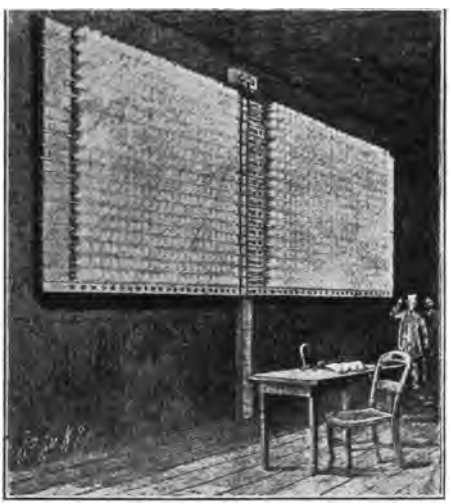
hopper under the street sidewalk. The same husky little engine ran a fan blower for forced furnace draft, and for supplying air to the stokehole, where it was greatly needed. Moreover, a system of blast pipes was provided to feed cooling air to the "Jumbo" armatures—first instance of the kind.

The fall of a sparrow may have its effect on the Milky Way, a theorem to the discussion of which Professor William James devotes some charming passages in his treatment of "Great Men and Their Environment." The present writer makes bold to assert that what Edison did at Pearl Street with the steam engines of his day was very largely the leading influence that has brought steam utilization into its altogether modern regime of superheat and the steam turbine. Agreement must be yielded to the assertion of James



PRIMITIVE REGULATING APPARATUS USED AT THE PEARL STREET STATION IN 1882

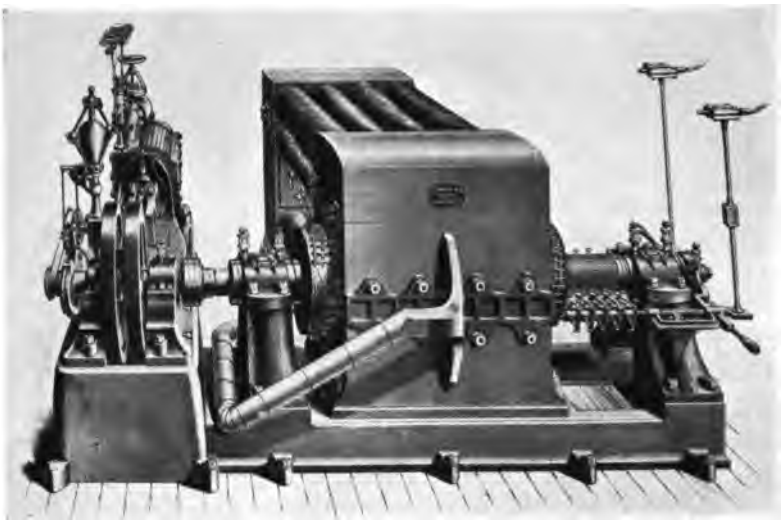
that originally all these things were flashes of genius in an individual head. Adopted by the race and become its heritage, they then supply inspirations to the new geniuses whom they environ to make new inventions and discoveries—and so the ball of progress rolls on. Mr Frank J Sprague, more of an authority on steam engines than the great Harvard psychologist, when discussing, in 1909, the award of the John Fritz gold medal to Mr Charles T Porter for his beautiful mechanisms, used as far back as 1867 to drive alternating current generators in France for lighthouses, spoke of the debt of electricity to Porter. Having tried out a high-speed Porter at the Menlo Park laboratory, Edison invited the great designer to give him half-a-dozen Porter-Allen engines for Pearl Street, each of the "Jumbos" to be driven by its own direct-connected engine. Sprague compared the intimate relationship thus established between the dynamo and the engine—steam and electricity—to an industrial marriage, one of the most important in the engineering world. Here in this inseparable partnership were the two machines economizing energy and space, enhancing efficiency, augmenting capacity, and reducing investment. It was well put by Sprague, and still "the greater lay before," in the coming ten years and in the steam turbine.



BATTERY OF A THOUSAND LAMPS ON AN UPPER FLOOR AT 257 PEARL STREET

The engines were each of 125 horsepower nominal, operat-

ing under steam pressure at 120 pounds at 350 revolutions per minute, with a piston speed of 933 feet per minute. They were mounted on the same bedplate as the dynamos, and could be speeded up to give 200 horsepower. The tenth of the famous Edison *Bulletins* dated June 5, 1882, stated that at 110 volts, the generators would supply current to 1200



THE EDISON CENTRAL STATION DYNAMO FOR 1200 SIXTEEN CANDLE POWER LAMPS

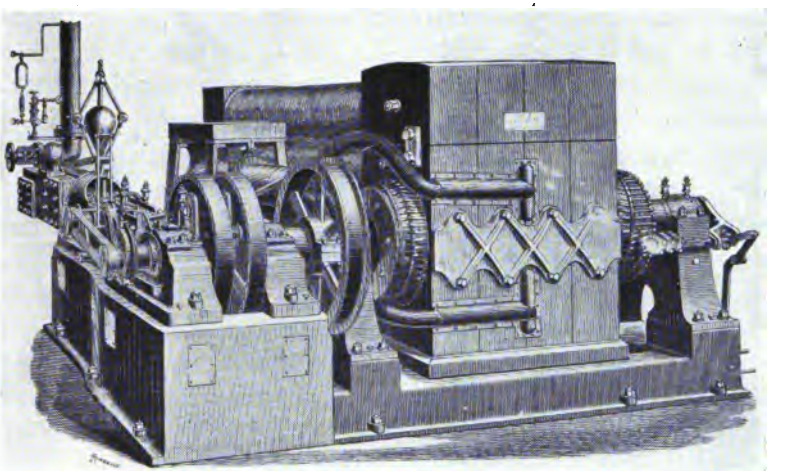
sixteen-candle power Edison lamps, but in later tests and emergencies they were run up to 1750 lamps. In the month of May, 1882, three of the "Jumbos" had been delivered at Pearl Street; and on July 5 the first of them was put into operation with the Porter-Allen engine. Three days later current was switched into a bank of 1000 lamps upstairs—the first real utilization of Pearl Street current. But at the moment there was not a single testing, indicating or recording electrical instrument in the place. The generating units were grouped in lines parallel to the sides of the building,

EDISON'S STEAM DYNAMO—MENLO PARK

three in a row. The main busbars of the station, double half-round copper bars, such as were used in the No 1 two-wire Edison underground tubes, were fastened to the side walls, with a connection between them across the ceiling. To these busbars the dynamos were connected by flexible copper cables, which spanned the space between the wall and the upright copper rods attached to the arms of the dynamo brush holders. One of each pair of copper uprights was furnished with safety catch holders, but the other connection was solid copper bars. In turn, all this was connected through the busbars by copper arms carrying safety catches at the outer Pearl Street end of the building, to the exterior Edison service supply tube feeders.

Above the main busbar was a set of auxiliary busses leading to the test lamp bank upstairs and connected to one pole of each dynamo ahead of the switch, and on the other pole to the corresponding S or N pole of the main bus. Thus the dynamo could be thrown on the lamp bank for testing, or for giving the particular engine a load, before closing the main switch that connected the various dynamos in parallel

on the main bus. This main switch or "circuit breaker" was one of the pioneer types of "knife" switches, with the contacts in series—an unusual breaking capacity being thus secured. It was operated by avoirdupois and main force, the attendant putting all his weight and muscle onto a long handle pivoted at one end, and released by powerful steel springs held by a trip pawl. In front of the main contacts carried by the switch handle, was an auxiliary blade for the field circuit, which always insured contact before the main line contacts engaged, and breaking after the main circuit had been broken. Supplementing this field switch was a plug switch attached to the wall and connected to a field circuit busbar running the length of the station, with an auxiliary break through a lamp resistance so as to furnish a by-path for the field discharge. The dynamo fields were controlled from the upper floor by simply moving simultaneously, by means of a horizontal shaft and bevel gearing, a number of horizontal contact arms across contacts connected with copper wire



EDISON'S LARGE DYNAMO ELECTRIC GENERATOR, 1882

BROAD AND WALL STREETS, 1882

resistances or spools wound over wooden frames. The absence will be noted of a central switchboard, the control switches for each dynamo being at first located at the machine. Pressure was regulated through an automatic indicator, with an electromagnet across the main circuit, its pull being opposed by a heavy spring. The armature of the magnet carried a contact engaging two relay contacts. On the side where the pressure was high, there was a red lamp in the relay circuit; on the low, a blue. Normally, neither lit up; but if the electromotive force rose one or two volts above the desired limit of pressure, the red lamp flashed; and the attendant turning the hand wheel of the field regulator threw some resistance into the field circuit of the machine running high. If, instead, the blue lamp lit up, resistance was duly cut out. The plant had several of these indicators which were taken frequently to the Edison Machine Works, at Goerck Street, to be ad-

justed by comparison with a Thomson reflecting galvanometer using current from some Daniell cells.

A little later, working up some of Edison's ideas that burst out daily as points developed, this very primitive indicator was supplanted by the "Bradley Bridge," a rough form of the Howell pressure indicator used for many years in Edison stations. Moreover, while it took more time and special invention to get all the general metering taken care of in the station itself, no time was lost by Edison in introducing his electrolytic meter to be an exact analogue of the gas meter. On one of the upper floors of Pearl Street was installed a meter room, where the plates of the Edison meter were prepared and weighed.

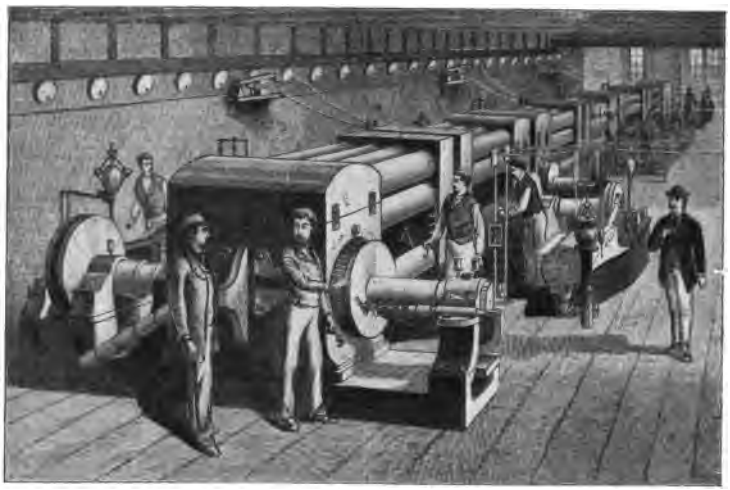
This is as good a place as any to pay tribute briefly to the merits of that meter, adopted at a time when nobody else had given any attention to the measurement of current supplied at the point of consumption—the customers' premises. Edison introduced the "European plan" into charging for electricity supply and use. If anything could possibly run counter to the old notion that Edison was haphazard, empirical, happy-go-lucky in his methods, it was surely his inveterate habit of trying all things, proving all things, testing all things, measuring all things. The principle of his electrolytic meter is that illustrated in the ability of an electric current to decompose chemical substances. Edison, being a great chemist as well as electrician, naturally hit on that method. His meter was a deposition bath, summing up some of the modern electrometallurgical processes. It consisted of a glass cell in which two little plates of chemically pure zinc were placed in a solution of zinc sulphate. When a customer used his lamps or motor, a certain definite tiny quantity of the current then used was diverted to flow through the meter from the positive plate to the negative. Hence, the latter increased in weight by the metallic deposit on it of zinc carried over from the positive plate; and this difference

BRONZE TABLET MARKING THE SITE OF THE FIRST EDISON CENTRAL STATION
AT 255–257 PEARL STREET

This tablet was erected in 1917 by The American Scenic & Historical Society and The New York Edison Company

could be and was checked up by periodical removal and weighing of the plates; say once a month. Several devices and methods protected this cheap and simple device from defective recording, and a themrostat with a lamp in circuit kept the solution from freezing at low temperatures. At one time, the meters in use represented 75 per cent of the entire lamp capacity of all the existing Edison customers. Up to October, 1896, The New York Edison Company used such meters exclusively on customers' premises, about which time came the transition to mechanical meters, perfected largely through the genius of Elihu Thomson; so that on September 1, 1898, there were installed on the New York system 4874 chemical meters and 5619 mechanical meters.

Another measurement feature that may well be referred to here is that of underground service testing. Mr S S Wheeler in some autobiographical notes says: "Methods were elaborated carefully for measuring the total leakage each day without interrupting the service, and kindred methods for determining the proportion of current that went out to each part of the old First District, downtown, south of City Hall. This was done by measuring the difference of potential between the switchboard and the outer end of each of the twenty 'feeders.' A mammoth galvanometer was gradually designed for this work and set up. It consisted of two single silk fiber suspension reflecting instruments, one placed above the other. To keep this arrangement free from the stray magnetism of the station, the iron shell of a small portable steam boiler was lowered over the novel outfit, completely enclosing it, with two holes in the shield for the beam of light to come out and be read. The scale was placed at a distance of three meters, and a double scale was made out of the usual cardboard printed meter scales, but taking three graduations as one. The instrument table and chair for the reader operator were set between the galvanometers and the scale, facing the latter. Instead of the ordinary narrow slit to permit the pas-



THE DYNAMO ROOM
First Edison Electric Lighting Station in New York
Scientific American, August 26, 1882

sage of the ray of light from the reflecting mirrors, a focussing lens was used, so that the picture of the filament of the indicating lamp appeared on the scale."

Another odd phenomenon noted just as Pearl Street was about to go into operation was the appearance of considerable current coming from the underground network, with little ostensible source. It was in reality earth current, about which very little was then known, save by submarine cable workers and telegraphers, who disliked it more than radio operators now hate "static." Edison, applying at once his experience at the key, sent Wheeler off to Tillotson's old electrical supply shop in Dey Street for a telegraph relay, and then they proceeded to get an idea of the strength of the stray current by seeing how it operated the relay. Both of the eager diagnosticians of Mother Earth's strange vagabonds spent several days and nights in the Station building, without leaving it, at the very time the start was due. Cots were

brought in for them and put up right alongside the generating units.

As a matter of fact, however, steam engine troubles were much more serious than electrical. Edison would endure no flicker in his lamps; he must have perfect regulation. Mr Charles L Clarke, who brought to this early work a consummate all-around engineering skill, furnishes a very interesting note as to the problem, the solution of which led to the adoption of the Armington-Sims engine at a very early stage. He says, of the "hunting" or "seesawing" of engines when put in multiple: "At the Pearl Street Station the machines were supported on long iron floor beams, and at the high speed of 350 revolutions per minute considerable vertical vibration was given to the engines. The writer is inclined to the opinion that this vibration, acting in the same direction as the action of gravitation was the primary cause of the 'hunting.' In the Armington-Sims engine the controlling forces in the operation of the governor were the centrifugal force of revolving weights and the opposing force of compressed springs; and neither the action of gravitation nor the vertical vibrations of the engine could have any sensible effect upon the governor." Wheeler notes, moreover, that to overcome such "racing," "A remarkable mechanical device was made at the Edison Machine Works. It was constructed in a great hurry, and applied at once. It consisted of a line shaft, placed along the wall, made of a shaft inside a tube; the shaft and the tube being bent in opposite directions and then riveted together. The object was to secure torsional rigidity. Levers were clamped to the shaft, connected to the governor rods of each engine. The governors were all in this way tied together mechanically," so that if one engine went fast, all the engines were compelled to do real "team work" and go fast also. As a historical fact, Wheeler comments, the first instance of coupling up the dynamos was actually that of tying into the system the small machines of the "isolated" Edison plant

THE LAST OF OLD PEARL STREET

that had by urgent wish of James Gordon Bennett, been installed in the building on the corner of Fulton and Nassau Streets.

The best reminiscence to hand of what went on in the trial runs of the unruly "Jumbo" units hitched together is, however, that given by Edison himself. He admits that for once "my heart was in my mouth," and with that the row began. "Then we started another engine, and threw them in parallel. Of all the circuses since Adam was born, we had the worst then. One engine would stop and the other would run up to a thousand revolutions; and then they would seesaw. The trouble was with the governors. When the circus commenced, the gang that was standing around ran out precipitately, and I guess some of them kept running for a block or two. I grabbed the throttle of one engine and E H Johnson, who was the only one present to keep his wits, caught hold of the other, and we shut them off." One of the sprinters, who got only so far as the end of the dynamo room adds: "It was a

terrifying experience, as I didn't know what was going to happen. The engines and dynamos made a horrible racket, from loud and deep groans to a hideous shriek, and the place seemed to be filled with sparks and flames of all colors. It was as if the gates of the infernal regions had suddenly been opened."

The clever shafting experiment was evidently not enough to ensure perfect operation in the future; and Edison had the great good luck to find the man who could help him out of a very serious situation. "I got hold of Gardiner C Sims and he undertook to build an engine to run at 350 revolutions and give 175 horsepower. He went back to Providence and set to work, and brought the engine back with him to the shop. It worked only a few minutes when it busted. That man sat around that shop, and slept in it for three weeks, until he got his engine right and made it work the way he wanted it to. When he reached this period, I gave orders for the engine works to run night and day until we got enough engines, and when all was ready we started. Then everything worked all right. One of these engines that Sims built ran twenty-four hours a day three hundred and sixty-five days in the year, for over a year before it stopped."

The important date, September 4, 1882, has at last arrived. The names of those present must be set down. Not many survive, but nothing on earth could tempt those who do to give up the honor and glory of the occasion. The immediate Edison group at the moment or who dropped in later in the day comprised, alphabetically,—S Bergmann, C S Bradley, H M Byllesby, H A Campbell, C L Clarke, Charles Dean, T A Edison, Calvin Goddard, E T Greenfield, Julius Hornig, John Hood, Samuel Insull, E H Johnson, John Kruesi, John Langton, John W Lieb, W D MacQueston, W H Meadowcroft, M F Moore, J P Morgan, Augustus Noll, H C Patterson, F A Scheffler, H J Smith, Francis R Upton, J H Vail, S S Wheeler, Charles Wirt, W S Andrews

and a few others whose names unfortunately escape us. Among the old associates of Mr Edison who were in Europe at the time may be mentioned Mr Charles Batchelor, Mr W J Hammer, Mr Francis Jehl and Mr E G Acheson. The technical press was represented by Joseph Wetzler, of the *Scientific American* and of the *Electrical World*. W A Anderson was there for the Board of Fire Underwriters. There were also several newspaper reporters, all of whose comments ran true to form for their respective journals. The *Tribune* described the lamp "a small blazing horseshoe that glowed within a pear-shaped globe, pendant beneath a porcelain shade." The *Herald* spoke of "supplanting the dim flicker of gas" and admitted that "last night it was fairly demonstrated that the Edison light had a very fair degree of success." The *Times* got down to details and explained that to get light, all you had to do was to "turn the thumbscrew"; but on behalf of men who work in editorial rooms it burst into gratitude for the beginning of a new night that would mean eyes preserved and health saved. The *Sun* as usual was picturesque and personal, and a sketch one could not spare is given of Mr Edison, who "wore a white, high-crowned derby hat and collarless shirt." He had, indeed, dressed for the occasion, and well-founded rumor has it that collar and tie and a long frock coat were lying around somewhere, discarded in a hurry. How could he possibly keep his hands off!

Chapter V

Introduction of the Edison Service—Early Customers

ONE of the leading indictments of this industrial era with its automatic machinery, of which Edison glories in being an exponent for these forty years, is that its revolutions, whatever boons have been brought to mankind, are also the origin and cause of some suffering as well. On the other hand, the contention may well be advanced that the benefits conferred by electricity in its applications have a minimum of sadness and bitterness to alloy their real value to society. It is, indeed, as urged by Mr C A Coffin, going further than any of the new agents at command to redress evils arisen since coal first laid its smutty fingers on life and civilization. Some aspects of such a plea for the higher merits of electrical development will emerge as the story of New York Edison service through four decades unfolds itself.

Neither political, social nor economic problems were in the minds of Edison and his backers when Pearl Street started up. Having put it very successfully in operation, what necessarily began to bother them was the intimate, vital question of income. As a matter of fact, it was not until February, 1883, six months after current was turned on and light was furnished that any charge was made. As Edison himself says: "We were not very commercial. We put many customers on, but did not make out many bills. After the Station had been running several months and was a technical success, we began to look after the financial part. We started to collect some bills; but we found our books were kept very badly, and that the person in charge, who was no business man, had neglected that part of it. So I got the directors to permit me to hire a man to run the Station." Mr Edison

BROADWAY, NORTH FROM CORTLANDT STREET
IN THE EARLY EIGHTIES

then engaged Mr Charles E Chinnock, superintendent of the Metropolitan Telephone Company of New York, an able, conscientious manager, to put the station on a commercial basis, and to pay, say 5 per cent on its valuation of $600,000. He also guaranteed Chinnock $10,000 if he made good, and later paid him that sum out of his own pocket.

If any one in these happier days, when everybody pays his lighting bills promptly, thinks Chinnock had a good time of it, the records again point in the other direction. That ten thousand was earned, every dollar of it, and first of all he had to clean up the situation growing out of the highly unscientific bookkeeping of his predecessor. Edison watched the proceedings closely. "I remember one man who had a saloon on Nassau Street. He had had his lights burning for

two or three months. It was in June, and Chinnock put in a bill for $20; July for $20; August about $28; September about $35. Of course, the nights were getting longer. October about $40; November about $45. Then the man called Chinnock up. He said: 'I want to see you about this electric light bill.' Chinnock went up to see him. He asked: 'Are you the manager of this electric light plant?' Chinnock replied, 'I have the honor.' 'Well,' he stated, 'my bill has gone from $20 up to $28, $35, $45. I want you to understand, young fellow, that my limit is $60.' "

Mr John Pierpont Morgan was somewhat more meticulous and particular, and wasn't at all sure about the inerrancy of that queer "wet measure"; so cards were printed and hung on each fixture in the Morgan offices in Wall Street. Each card noted the number of lamps on the fixture and the time at which they were turned on and off each day. The test was for a month, at the end of which the lamp hours were added up and figured out on an hourly basis. "Kilowatts" and "kilowatt hours" were a refinement quite unknown then to the art, the customers or the dictionaries. The total reached was then compared with the bill rendered by the Company. One likes to think of the great Morgan, dealing in millions, thus putting a new meter on test, to check it up. The results of the first month revealed an apparent overcharge. Mr Morgan chuckled. Edison took it quite serenely and suggested giving the little beggar another chance. Once more the same thing happened, and the chuckle became a broad grin; and E H Johnson didn't drop in quite so often to see his dear friend, J Hood Wright. Then Edison went "sleuthing" himself. He inspected the Drexel, Morgan offices carefully—the wires and fixtures critically—looked over the hourly records, and then asked who did the chores after dark. He was told that the janitor—really a very excellent chap—cleaned up the place. The janitor was sent for and when inquiry was made as to the light he used in mopping up the

floors, pointed to a central fixture carrying ten lamps. He had made no record of its nightly use—hadn't been asked to. Told to make note every night of his use of it during a month, he did so; and when the next bill came in, it was found that the meter had registered within a very small fraction the actual lamphour consumption as computed from the cards. The joke was on Mr Morgan, who became a highly enthusiastic advocate of a meter that could so much more satisfactorily stand interrogation than others who came after the financier's money.

In the very early days Edison liked to figure that chemical uses would furnish him with many customers, even to the extent of causing the establishment of such plants next door—a curious anticipation of what has taken place since Niagara and other great water powers have been subjected to the electric yoke. He was rather pleased over one unexpected confirmation of his ideas, when Chinnock went to him one day and announced that he had picked up a new customer for the equivalent of 250 lights. "I said, 'What for?' 'He has a place down here in a top loft, and has got two hundred and fifty barrels of 'rotgut whiskey.' He puts a lamp down in the barrel and lights it up—and it ages the whiskey!' I met Chinnock several weeks after and asked 'How is the whiskey man getting along?' 'Oh! it's all right; he is paying his bill. It fixes the whiskey, and takes all the shudder right out of it.' " The idea or process was patented afterwards.

In these modern times no set of men watch the weather reports more anxiously than central station operators. The New York Edison Company has long had also a system of direct meteorological observers scanning the horizon as do fire wardens in the forest reserves. But when "old Pearl Street" went into action that method was as unknown as military scouting by aeroplane. Edison took on a large contract with the Stock Exchange, and then came the anxiety

as to what might happen if a big thunderstorm suddenly rolled up out of the West on one of the dog days and the plant should be staggered by an overload. The expected happened. Edison says: "We had an idea like a steam gauge, called an amperemeter, to indicate the amount of current going out. I was up at Sixty-five Fifth Avenue one afternoon. A sudden black cloud came up, and I telephoned to Chinnock and asked him about the load. He said, 'We are up to the muzzle and everything is running all right.' By and by it became so thick we couldn't see across the street. I telephoned again and felt something would happen, but fortunately it did not. I said to Chinnock, 'How is it?' He replied: 'Everything is red-hot and the amperemeter has made seventeen revolutions!' "

To tell the truth, both the Stock Exchange and Morgan's did "go off the system" about this time for another reason. Fuses were the "foxes in the vines" in those days. The fuses used in the street underground junction boxes were first tested with great care at the Edison Machine Works, in the open air; but when they were placed in the street "catch boxes," which were very small, the fuse capacity was reduced to one-half or less on account of the accumulating heat in the confined space. The startling result was that the fuses on the feeder at this vital point in the "Street" near Broad, "blew." Within a few minutes all the feeders supplying the entire network had followed suit, and that part of the system "lay down." All the lights were out! To aid in testing out and finding how matters stood, Bradley and Wheeler at once connected up two spare feeders not in use, disconnected at Pearl Street, and then they gradually brought up the potential until a dull red light was thrown all over the First District. Encouraged by this partial emergence from total eclipse agitated directors, who had reached the plant posthaste, insisted vehemently that the pressure be fully restored. Anything to prove the new system was all right! This order

THOMAS A EDISON IN HIS LABORATORY

From an instantaneous photograph taken specially for *Frank Leslie's* Illustrated Newspaper

was of course obeyed, with the natural result that the two spare feeders blew up in turn. Nothing was left to do but go around in the pouring tropical rain, open all the catch boxes, and fuse again all the feeders—a nice clean little operation that took several hours—when fortunately most of the downtown New Yorkers had gone home. Some scapegoat was needed. The Company issued its regrets stating that the guilty employee had been "fired" for his carelessness. He had. Wheeler was at once made electrical engineer of the Edison Tube Works by John Kruesi, installing the underground mains at Fall River, Mass, where a little block lighting service was started in April, 1882. And then, to make sure the punishment fitted the crime, Wheeler was "sent up the River" to Newburgh by Frank S Hastings, treasurer of the parent company, who was very proud of the fine little show plant being installed there and had called for a competent man to superintend the work and run the plant.

Speaking of fuses, this incident recalls the fact that during the first year of incandescent lighting in New York City fuses were applied to only one leg of each circuit; the "cut out blocks" that receive the screw plugs containing the fuses being arranged for one fuse only. It was learned from sad experience that often a fuse would be on one leg of a circuit in one place, and in some other place requiring a fuse, would be on the other leg. Hence, when the opposite legs were accidentally grounded, a "short circuit" was produced, there being no protection. Then, for the first time, fuse blocks were made with two fuses.

Another mishap of the kind that threw Wall Street into temporary gloom was more humorous and less serious in nature, though typical. "One afternoon," says Edison, "after our Pearl Street started, a policeman rushed in and told us to send an electrician at once up to the corner of Ann and Nassau Streets—some trouble. Another man and I went up. We found an immense crowd of men and boys there and in

the adjoining streets—a perfect jam. There was a leak in one of our junction boxes, and on account of the cellars extending under the street the top soil had become insulated. Hence, by means of this leak, powerful currents were passing through this layer of moist earth. When a horse went to pass over it, he would get a very severe shock. When I arrived, I saw coming along the street a ragman with a dilapidated old horse, and one of the boys told him to go over on the other side of the road, which was the place where the current leaked. When the ragman heard this, he took that side at once. The moment the horse struck the electrified soil, he stood straight up in the air, and then reared again; and the crowd yelled, the policeman yelled; and the horse started to run away. This continued until the crowd got so serious that the policeman had to clear it out, and we were notified to cut the current off. We got a gang of men, cut the current off for several junction boxes and fixed the leak. One man who had seen it came to me next day and wanted me to put in apparatus for him at a place where they sold horses. He said he could make a fortune with it, because he could get old nags in there and make them act like thoroughbreds."

On October 1, 1882, within a month of starting, the Company had 59 customers, and on December 1 it had 203, for whom it had installed 5228 lamps of which 3144 were then in actual service. At the beginning of 1883, it had 231 customers, and as already noted, the regular collection of revenue for service began in February. But the first bill for lighting based on Edison meter readings was collected on January 18, 1883, from the Ansonia Brass & Copper Company, Cliff Street, for $50.40. After the lapse of a year, September 1, 1883, the system had 455 customers for its service, and no fewer than 11,192 lamps had been installed, although only 8218 were in operation. During that year the Company lost $4,457.50; but in 1884 the deficit was turned into a handsome profit of $35,554.49 although the Company did not pay its first

quarterly dividend of 1 per cent until August 1, 1885. Perhaps the increase in the life of the lamps had something to do with that, as the average of 400 hours in January had risen to 914 hours in November. A year later, the Company had reached a life of 1347 hours per lamp. Moreover, in 1884 began the remarkable diversification of electric service, now one of the leading phenomena of central station operation—for fan motors went on the circuits, and various motors were introduced for industrial uses. That same year, 1884, the great initial work begun by Edison, in 1882, in familiarizing the public with the idea of universal electrical application for everybody, was rounded out by the first American Electrical Exhibition at Philadelphia.

This is a natural point of pause to consider briefly a few of the essential auxiliary inventions that went with the development and demonstration of the fundamental Edison central station service. For the exterior system, underground, were required the conductors, manhole boxes, T-joints, service boxes, service switches and fuses, connectors, and special kinds of wire. For the use of the customer, indoors, were needed all kinds of fixtures, beginning with the lamp socket, and running the gamut through meters, minor switches, fuse blocks, electroliers, insulating joints and methods of interior wiring,—now all so generally standardized that the younger customers of The New York Edison Company can have no idea of the primitive character of much of the early material or the welter of maddening confusion attendant on the effort of nearly every arc lighting company to take on incandescent lighting. As soon as Edison had shown its feasibility and desirability, such companies were eager supporters of his more or less ambitious rivals. It is quite impossible to do more than "characterize" all such advance, but the essential facts belong to this story because so much of it was the work of the old Edison Electric Illuminating Company, directly, or was tried out by the parent

OLD EDISON
CHEMICAL METER

company on the New York circuits. A great deal of such important detail invention is summed up, for example, in the unpublished record of what Mr Luther Stieringer did for the "ceiling block" and the "insulating joint." In 1882–3 there were no such things as fixture insulators. If the incandescent lamp was introduced anywhere, it was the practice to twine and tape the wires on the old gas chandeliers and then connect them with the lamp sockets screwed under the gas burners. Out of that grew the "combination fixture," which survives usefully to this day. There were frequent fireworks in a thunderstorm with snapping sparks between the chandelier and the festooning wires, and one vivid display which scared nervous guests out of a hotel and led Stieringer to devise the insulating joint—which effectually separated the two services and was immediately adopted.

Stieringer, who was a grand old gas plumber sublimated to the tenth degree and an Edison loyalist raised by enthusiastic admiration to the hundredth, gave the art a great gift in his

"ceiling block." The idea of the use of the flexible cord as an accessory of the application of the incandescent lamp is really older than the commercial lamp, while the flexible cord itself is none other than our ancient friend the flexible gas tube, with two wires running where the hole used to be. At first, it did not occur to practitioners of the lighting art to borrow the flexible cord from the practice of the district telegraph and telephone people. Stieringer, encouraging this notable departure from rigid pipe and the use of molding strips, himself recalled the first use of flexible conductors as pendants from a ceiling support at Edison's own house at Menlo Park, where—used to provide a temporary device—Stieringer prepared webbing made of two thicknesses of stout tape between which the conductors were placed. An improved form of this was used in J Hood Wright's house and other places in New York City. The only alternative was the very light telephone cord, as the ordinary paraffin wires of commerce, known with grim jocularity as "undertaker's," single or double in form, were all tabooed by reason of inflammability. Midway in 1883, Edison approved a form in which the lamp conductors were wound with cotton, wrapped separately with Kruesi insulating tape, laid side by side, and then both wrapped again with the same tape. This would support the lamp and socket from a knot above some rigid support like a cleat forming part of a device on the ceiling. Six miles of such a conductor were used by Byllesby and Stieringer at the Louisville Exposition of 1883; but while the experiment as to the particular conductor was not repeated, the ceiling block thus came into the art to continue, and to be perfected in New York City, where refinements were gradually added. The truth remains that at first the "ceiling block" was regarded as a temporary fixture preluding permanent wiring and the adoption of chandeliers; and as Stieringer remarked sadly, there was the natural opposition of "electrolier" manufacturers, who derived no profit from the growth of the

cord industry. Besides, "at this stage of the development of the art, nobody would assent to the expense or recognize the need of a fusible cutout for each lamp." The present writer has had the pleasure of adding to the Edison lighting museum, from the collection left him by Stieringer, some very interesting examples of the archaic devices with which the citizen of New York was first "hooked up" to his local company.

Odd as it may seem, it was around the beginning of service by the Edison Electric Illuminating Company that the first attempt of any kind was made in the United States to train electrical artisans; indeed it might even be said that except for what Prof W A Anthony did at Cornell University, it was the first American effort to educate electrical engineers. Nor did Anthony prepare his own textbook as did Edison, whose manual for plant operation is of the extremest rarity and correspondingly valuable. But that admirable booklet was not enough, and one of the difficulties in getting the First District in operation lay in the scarcity of skilled workmen to wire the buildings. A night school was therefore established at Sixty-five Fifth Avenue, of which Mr E H Johnson, just back from his successes in England, was put in charge as head, with Mr C L Clarke as the technical instructor in the new art. Pupils flocked to this novel academy, not only wiremen and bellhangers, but students from the technical schools and colleges, who often came well prepared in every way but electrically. Even the great Lord Kelvin said in those days that an electrical engineer was 90 per cent mechanical engineer. But here was a job that could not be quite reconciled with that point of view and the necessities of the New York Edison system. So at it went Johnson and Clarke, chalk in hand at the blackboard and with all the appliances for ocular demonstration; and, moreover, with a real place on the payroll waiting for the competent graduate. Many of these original New York Edison students hold high positions in the electrical world today, and the list of members of the

New York Electrical League, or the roster of the New York Electrical Contractors Association, contains many a name first to appear in the electrical field at this time and in this way. As already intimated organized electrical engineering training was not to be had; Edison was the first American, with Franklin L Pope, in 1869, to advertise himself as an "electrical engineer," a quite unknown profession. It was not, however, until 1884 that the American Institute of Electrical Engineers was founded, and not until 1888 that Columbia University of New York City took up the new study as a distinct course.

Another aspect of the new departure made with the going into operation of old Pearl Street belongs in the sociological relationships with education. It has been noted that among those attending the simple exercises on September 4, 1882, was a well-known representative of the New York Board of Fire Underwriters. A new "hazard" had come into existence. Careful study was given to the subject, and the new regulations and requirements were embodied in the rules formulated by that Board late in 1881 and adopted formally January 12, 1882; to be subsequently endorsed by other boards in the various insurance districts of the country. The National rules growing out of all this preliminary work and experience, compiled in 1897, govern the art today.

And on the word "Fire" this chapter may fitly close, although Pearl Street Station was not dismantled until many years later, and the building did not pass out of the hands of The New York Edison Company until 1895. It ran in very successful operation until January 2, 1890, when it was partially destroyed by fire, causing the only serious interference with service to customers that has ever occurred in the forty years' history of The New York Edison Company. But not a customer was lost. The fire was due to a heavy short circuit on one of the feeders from Pearl Street to Fulton and Nassau, reacting on the plant itself. Service was swiftly

resumed. Only No 9 was then saved of all the "Jumbos," to be a venerated relic. The boilers had better luck, as told before. No 9 still continued to function. But as Clarke put it with tears in his words: "The glory of the old Pearl Street Station, unique in bearing the impress of Mr Edison's personality, and, as it were, constructed with his own hands, disappeared in the flame and smoke of that Thursday morning fire."

Chapter VI

General Service Growth of The New York Edison Company

THE present writer had the honor of preparing for the United States Census Office as Special Agent the first report ever made to any government on the subject of electrical apparatus and supplies, but it was not done until twenty years after that memorable Fourth of September at old Pearl Street. It dated back to 1880 as the base year. In like manner were issued, in 1905, the first complete central station statistics the world had ever seen for the years 1890 and 1902. There are thus furnished points of comparison for any subsequent growth especially as these highly useful studies by the Census Office are made under Congressional mandate every five years, and thus serve also to cross-section not only the other industrial and manufacturing data compiled by the Government but to help explain and interpret the decennial statistics of population. Looking over the data, thus summing up the record of growth for the four lustrums of their expansive system of public utilities, the members of the National Electric Light Association, when enjoined characteristically at Atlantic City last May by Secretary Herbert Hoover to "Electrify America," could not help feeling that they had made a fairly creditable beginning in that direction.

This is a good opportunity to use a few of the figures to illustrate how marvellous has been the growth of The New York Edison Company in the period that runs back as far into the history of the last century as it has traveled into the twentieth. On later pages of this volume are given under several leading heads the chief items of its growth in service from 1882 to the present year. Now, in 1880, the total capital

applied to electrical manufacturing in the United States was only $1,509,758. That year came almost concurrently the great advances in the introduction of telephony and electric lighting, with the arc—but there were still no incandescent lamps. In 1890, the capital employed had jumped to almost exactly $19,000,000 and in 1900 it reached $83,130,943, a growth that even the automobile industry, which electricity first put on its feet, around 1900, might regard with respect. Turning to the Census Office data of 1902, for central stations, it is found that in 1890 the 139 in New York State had cost $31,183,618 and that out of their total income from all sources, of $4,174,534, no less than $2,272,374 was derived from arc lighting; while incandescent lighting yielded only $1,585,834, and the motor current sold was worth only $102,754. In 1902 the effect of the enormous revolution caused by Edison is seen in the fact that out of the income of 256 stations in New York State of $16,854,839, arc lighting was but $4,944,575 while that from incandescent lighting was nearly twice as much, or $7,976,232, to which should be added motor service, all practically done from "Edison" circuits, yielding a further income of $2,396,046. To that, moreover, should be added a very large part, if not all, of the income from miscellaneous service, namely $1,537,986 and some portion of the arc lighting. The extraordinary fact remains that in ten years the service from other than "Edison" circuits had fallen from about 55 per cent of the total income to less than 25 per cent. Such figures are graphic, and become even more startling when taken on the larger view of the country as a whole and over the whole period since the New York Edison system modestly started out to prove that the young inventor of Menlo Park was right.

The arc light, not available for interior lighting except in large spaces where the glare and flicker might be more bearable, soon established itself on the streets and highways of America. Radical improvements in methods of operation,

and in material used, minimized all the earlier objections to it, save that of lack of subdivision.

But the statistics of The New York Edison Company tell something of a desuetude that began with the iconoclastic onslaught dating from September 4, 1882. Taking 1913 as perhaps the best year to regard as the close of the epoch when, as involuntary residuary legatee, the Company had gathered up the fragments of the old arc lighting companies, it is seen that on December 31 of that year it operated no fewer than 35,617 arcs. At the moment these words were penned, July 15, 1922, only 9435 arcs remained connected to the Company's circuits. Edison had himself tried to inaugurate such a change soon after Pearl Street started, but though he did not succeed at the moment the relentless march of progress has obviously brought the process very nearly to the finale. In 1919 the total value of arc lamps made in America in round figures was but $606,000 while that of incandescent lamps was $57,646,000!

Stationary motors constitute the only other service comparable with the arc and the incandescent lamps in longevity as part of the New York Edison system. In the early days of Pearl Street, a few small series motors to be run on arc circuits or by batteries were on the market. The business was utterly trivial, and the method of operating a power motor in series with a lot of "2000 candle power" arc lights might well be considered hazardous. But the Edison system obviously "opened the door to China," although it was not until the end of the first decade of New York service that the capacity of direct current motors receiving Edison current reached 3807 horsepower. In 1902 it had already increased to 62,377 horsepower and then in the early years of this century came a tremendous jump to no less than 392,704 horsepower in 1912. The present year, on June 30, saw that capacity doubled to the really imposing figure of 790,000 horsepower. No attempt will be made here to enumerate the industries

CHRISTMAS SHOPPING BEFORE THE AUTOMOBILE

Drawn by W H Shelton. *Harper's Weekly*, 1882

in which such electric power is utilized. It would be a very easy task to count up the unelectrified trades and crafts among the 32,626 manufacturing establishments of Greater New York.

But that is only one aspect of the power subject. The American housewife has been confronted by two disheartening phenomena—the increased cost of living and the decreased supply of domestic help, and the dispute is still on as to whether the world can get back to normalcy in its price ratios, or whether the Great War has not marked definitely one of those stages in economic relationships, or financial condition, that leaves the old units of value shifted to a new bed like the dislocated, ever-rising strata of the earth. Anyhow, in this grim age of grinding upheavals, the one fact stands out that electric service is pretty much the only thing whose cost has really gone down, relatively, to the benefit of the public, as compared with advances in the general cost of living. Some recent curves that show the enormous increase in the sale of the three chief domestic electric conveniences may be associated with and reflect the decline in the immigration of women into this country from Europe.

The statistics given on later pages do not differentiate all this domestic supply from the industrial, nor do they in any way touch on the saving and convenience to the housewife of the numerous electric appliances or the wonderful alleviation afforded to all New Yorkers the year around by the fan motor, now so ingeniously contrived that it can "blow hot and cold." No man living can tell how many millions of fan motors are in use in the world, but on Manhattan Island their busy hum drowns that of the not more ubiquitous mosquito these hot summer days and makes the town as breezy as Manhattan Beach.

Fortunately, the Company's statistics do reveal the story of the use of electricity for heating and cooking. It is seen that not until the last century was a-dying did any record

appear of current sold by the Company for heating and then it represented only 86 kilowatts. In 1896–7, the inventor Hadaway installed an electric range in the Fifth Avenue mansion of Andrew Carnegie, and that wholly practicable equipment set the ball rolling; although very few could then see in it more than an expensive toy for the wealthy customer. Not until 1907 was the sale boosted to 1000 kilowatts. At the present moment, fifteen years later, the use of electricity for heating is distinctively identified to the amount of 16,500 kilowatts for 1922; and anyone who attends the Electrical Exposition this year will have an opportunity to see how small a beginning that is, in view of the perfection and profusion of the heat devices already obtainable. Let it not be forgotten that the only satisfactory picture of the coming City Beautiful, lying between the Statue of Liberty and the Hudson Palisades, is that wherein no fuel is burned save by gas works and central stations on its very outer edges, and where for a landlord to make smoke will be a grave misdemeanor.

Which brings us gracefully to the electric automobile work of The New York Edison Company, under whose fostering auspices some years ago, in 1899, was held the first electric automobile parade ever seen. It seems but yesterday that Mr Isaac L Rice was inviting friends to take a ride around in his electric, the only one in town; while over in Brooklyn Mr A L Riker, in 1894, was building the first electric 4-wheeler that ever ran on New York's streets. In 1902, the New York Edison system supplied only 1386 kilowatt hours for charging storage batteries, practically all for automobiles, but by December 31, 1912, the service had risen to 12,983 kilowatt hours. In 1914, the Committee on Electric Vehicles of the Ohio Electric Light Association gave authoritatively some very interesting data as to vehicle development and stated that New York City then had 498 passenger or private electrics and 1700 commercial, although the total compared

unfavorably with that of Chicago which then had no fewer than 3136. There has been a considerable advance recently, and 1921 showed a storage battery service from Edison circuits of 31,500 kilowatts, but the fact remains that of late years the exploitation of the electric vehicle in New York City has not been in the passenger field but very heavily in that of delivery wagons and trucks, as exemplified by the American Railway Express, which in New York and throughout the country is operating no less a fleet than 1258 electric trucks. The advocacy of the electric vehicle by The New York Edison Company, its constant and persistent pusher, was never more energetic than today, while as example is better than precept it utilizes in its own transactions a fleet of no fewer than 105 electric conveyances of various types.

Concurrently with the introduction of the Edison system came the modern skyscraper, whose erection, existence and operation would be impossible without the electric appliances and utilities. Imagine, if one can, all the communications exchanged in a business day in New York by telephone, wireless or telegraph being handled by postmen and messenger boys! The famous old Tower Building on lower Broadway was but eight stories high, but it had steel framework and passenger elevators making it the true lineal ancestor of all the colossal structures that have since made New Yorkers cliff-dwellers either at business or in the home. What Otis, Sprague, See and others have done to facilitate the vertical travel in modern cities cannot here be discussed, but it must be noted, if merely in passing, that mighty few of about 1000 tall buildings in New York City are without the electric elevator, as to which Edison was very anxious even when he began work at Pearl Street, and now he seems destined to abolish "walkups" and stair climbing altogether.

Discussion of the incandescent lamp itself and its use in New York City, as part of the general growth of the Company, has been reserved as a kind of climax. It was not until

BROADWAY AND FULTON STREET, 1886

1901 that the Company reached its first million of lamps connected. All of these were of the Edison carbon filament type, although during 1892 the process was resorted to of treating the filaments by depositing on them a dense coating of graphitic carbon, insuring a uniform cross section throughout the length, increasing life, and decreasing the black deposit on the glass of the bulb. Then, in 1894, came the oval loop or "squirted" filament with a short central anchor to support the loop, whereby the tip-end candle power of the lamp was better than doubled, with more uniform distribution of light, in all directions. A still more important improvement was the introduction of the chemical process, by which all the final traces of air were removed from the bulb. About 1905 came the "Gem" filament, of ordinary carbon subjected to the intense heat of the electric furnace, increasing the refractory quality of the filament, enhancing the life, and raising the

efficiency to 2½ watts per candle from the old original 3.10. Then came all the wonderful series of metallic filaments, harking back to the work done ab initio by Edison and his many brilliant colaborers. This series, including platinum, tantalum, osmium, and other rare metals, now has its leading representative in tungsten. The filaments of this, at first made from powder or paste, and now wire drawn and used in globes filled with some inert gas, are the furthest advance illustrated today on the New York Edison circuits, in this modern art of incandescent lamp manufacture. Practically the whole of the enormous gain thus briefly set forth has gone to the lamp user. What the change amounts to may be inferred from the 1922 report of Mr Frank W Smith, chairman of the Lamp Committee of the National Electric Light Association. He gives the total sales of tungsten filament lamps made in the United States for the year 1921 at 160 millions, although it is also estimated that it reached 202 millions the year before. There were only 6 million carbon filament lamps, "so that the early disappearance of the carbon lamp may be looked for." At 115 volts pressure, 35 per cent of the lamps were called for, 28 per cent at the old standard 110 volts, and 23.6 per cent at 120 volts. Of all this wonderful 160 millions, 20.6 per cent were of the gas filled type. As to size, these lamps were 21 per cent of 25 watts size, but the largest number 21.6 per cent were 40 watts, and no fewer than 13 per cent were 60 watts, showing that the American eye has been educated up to a demand for much higher interior illumination than was acceptable forty years ago. To sum up all this, it may be stated that the Company estimates its circuits in New York to be carrying at this moment just about ten million incandescent lamps of all kinds. As to Christmas tree lamps, and decorative advertising work of all kinds that the lamp does—that must all be left to the reader's own daily observation.

Of course, in a sense, every inhabitant of Manhattan

Island is directly or indirectly a customer or beneficiary of the New York Edison service. Up to 1900, the Company kept an exact tab on its actual customers billed, and every one had his individual meter. About twenty years ago, there were over 16,000 customers, but ten years later the number of meters set was 169,000, giving roughly the number of patrons. On June 30, 1922, there were on the New York and United Edison's systems no fewer than 475,000 electric meters, which registered the total consumption of an installation of 25,000,000 units, of 50 watts, if it were all reduced to corresponding equivalents.

In closing this altogether inadequate summary of the way in which the New York Edison system functions for the millions for whom it is in "readiness to serve" all around the clock every day, note must be made of one quite interesting feature. Over half of the 6000 central stations of the country deal in electrical apparatus and supplies, or do the necessary wiring for a newly-connected customer. Some years ago, when it was a sheer necessity to continue to carry out contracts for wiring installation, the Company maintained a large and successful wiring department. Today it neither wires nor does it trade, although its main showrooms and numerous branch offices are literal expositions of all that is latest and best in appliances, aiding judgment in selection, guiding taste, and settling many questions which even in these days when every housewife talks electricity glibly and every schoolboy has pat the slang of radio, require the skillful decision of the expert. The wiring contractors of the city are among its best friends, for it ever creates new opportunity—electricity's other name.

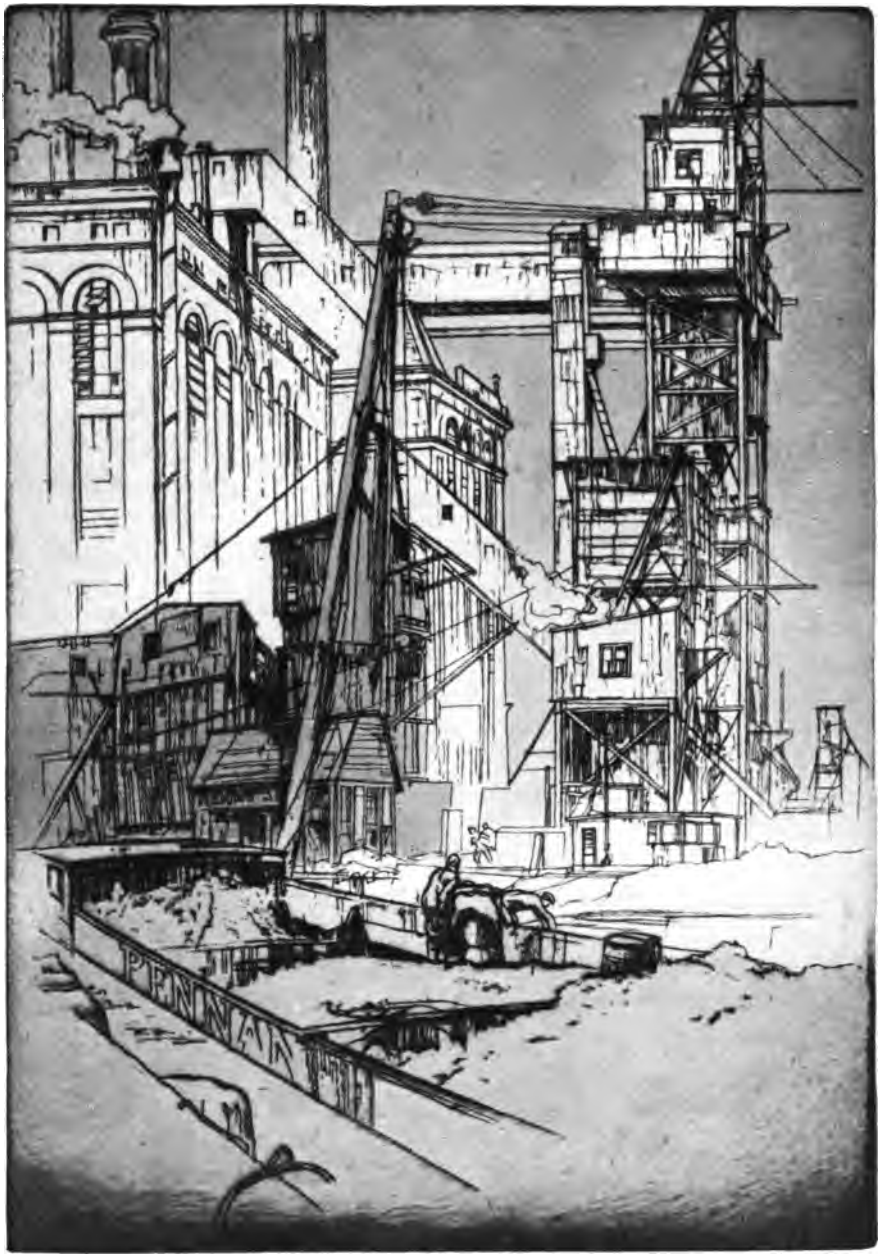
CHAPTER VII

The Successive Edison Stations on Manhattan Island

IN a lecture entitled "A Story of Three Decades" delivered, in 1912, before the employees of the Brooklyn Edison Company, Mr Samuel Insull said: "It took about three decades, thirty years, to establish the commercial value of gas. Owing partly to the differences in general conditions of living, and partly to the better original invention, it took but one decade to establish the commercial possibilities of the electric power and electric lighting industry."

As a matter of fact, in his dates supporting this pregnant paragraph, the lecturer referred more specifically to events clustering around 1889, when the first Brooklyn Edison station went into operation. It was the year when Edison made his second notable exhibit in Paris, and when at the fruitful Electrical Congress of Paris the watt was authoritatively defined and adopted as the unit of electrical energy. It was the year when work was begun on the first real power transmission line in the United States, scaling the Rockies, for Telluride mining work in Colorado. Such a date, 1889, obviously serves for a new point of departure from the period when The New York Edison Company, emerging from the influence of the governing idea of its small districts, plunged heavily and with enormous momentum into the new era of steam and electrical engineering of which its huge plants on Manhattan Island are amongst the finest exemplars, and in many respects the typical representatives in this day of mass economics.

Only a very brief review can here be made of the engineering policies and practices embodied in The New York Edison Company stations of this year of grace. They illustrate at



COALING APPARATUS AND BARGES AT THE WATERSIDE STATIONS
Etching by E Horter

once modern refinements in intimate details of operation as well as the revolutionary methods that have totally recreated the central station art in forty years. Necessarily, attention will be paid rather to the new ideas and inventions than simply to the higher efficiencies of mere tuning up.

Until 1890, there was no real breaking away from the earlier traditions; and then it seemed as though the mere naming of the new unit of power sufficed to turn loose on the world a literal Niagara of watts and kilowatts. At once came a swift transition in both the steam and the electrical fields, and for the central station, these advances were, so far as the public was concerned, summed up in radical improvements in the incandescent lamps and its variants, like the mercury tube; the introduction of the electric motor and the development of numerous new electrical applications. For the central station, in its technical organization, the new era after 1890 comprised rapid perfection of compound, triple and quadruple condensing engines; the utilization of the storage battery for a gasometer function; the use of the rotary converter and the converter sub-station, the extended use of the alternating current for generation and distribution purposes; and, wherever available, the economic linking in the remote water powers with long transmission lines, huge step-up and step-down transformers, and higher voltages to rival in intensity of effect the very artillery of the heavens. The pace and push of all this engineering expansion has been rapid indeed, since 1890.

And yet, seen from a survey of the growth of the New York Edison system, it is all quietly evolutional rather than sensationally spectacular, and tells of a policy steadily pursued to put into service every new suggestion or help to try out the novel proposition in which may lurk the germ of better things. This is the curious aspect of Edison and all his works, of Edison and all his colleagues. For example, Edison in his early New York work laid out the city of that day in 36 districts

"THE HEAVENLY TWINS"
Duane Street Station

south of Fifty-ninth Street, beginning with the one around Pearl and Wall Streets—each district to be self-centered and to be dealt with as a market gardener cultivates his little acre or two. Such a plan was the very antithesis of the development of series arc lighting methods with overhead circuits, fed from one "central station" miles away; and yet Edison was "ragged" for such marvelous lack of caution and sanity! Now, it is a curious study to say the least, to take the list given elsewhere in this volume, of sub-stations, and see how that very selfsame district idea has been worked out and closely adhered to,with each sub-station center of its own district from the first to the latest, far beyond Fifty-ninth Street, yet all tied together as one huge network and all fed with energy by underground circuits—source and circuits as impregnable to disaster as human ingenuity can make them. Of the proposed numerous steam power plants, barely half-a-dozen were actually built, on an ascending scale of magnitude. The original plan of such small stations is still seen sadly exemplified in London, which has at this moment probably in excess of fifty generating plants for the electrical supply of its six million people—or about five times as many plants as Greater New York. The objections to multiplicity of steam power plants in a modern city are so generally recognized that the Edison plan warmly approved forty years ago would not even be suggested today. The wonder is that a sensitive public is still so tolerant of large isolated plants within the municipal borders with all their drawbacks of coal haulage, ash removal, gas and smoke creation, excessive coal consumption, large consumption of water needed for sanitary and fire purposes, and other disadvantages. When Pearl Street was laid out, steam and electrical units were so painfully small that a few hundred horsepower expressed their capacity. Even up to the time when the Edison Company, in 1888, erected its second and third generating plants at West Twenty-sixth Street and West Thirty-ninth Street—

now sub-stations—the steam engine units reached a maximum of only 200 horsepower. It was not until Duane-Pearl Street equipment was reached in May, 1891, that engines above 1000 horsepower were introduced; and that plant was designed for ten vertical engines of 2500 horsepower, each with a pair of 800 kilowatt dynamos; two 1250 horsepower engines with a pair of 400 kilowatt dynamos; and two 600 horsepower engines, each with a pair of 200 kilowatt dynamos. Up to the time that 5000 horsepower hydro-electric units were put in operation at Niagara in the autumn of 1895, no alternating current generators—the coming types—had been built in excess of 1000 horsepower.

Still pursuing, in 1892, its method of direct current generation, the Company bought for its new station at Fifty-third Street its first storage battery auxiliary, an imported Crompton-Howell Battery with the modest capacity of 2000 ampere hours, which was the beginning of storage battery use in connection with central station Edison service in the United States. With his numerous generating plants, closely tied in, Edison, who had a poor opinion of the storage batteries of the early eighties, had then expressed quite epigrammatically his judgment that a ton of coal was the best storage battery on the market; but now, again, the modified conditions led to the change in operating practice. It is quite interesting to note that in 1892, on December 15, always a peak period of the year, the maximum load in the downtown district reached 21,000 amperes or 45,000 lamps of 16 candle power; while the day before, the newer uptown load was just about the same—20,320 amperes.

In 1895 the Edison Company installed the first steam turbines to go into central station service in America. These were imported from abroad and marked the beginning of the supersession of reciprocating engine generators by steam turbine generators in this country. They comprised 2-300 horsepower DeLaval steam turbines, each connected to two

100 kilowatt dynamos arranged for Edison connection, one of the units being installed in the then new and "up to the minute" Twelfth Street station and the other in the older Thirty-ninth Street station.

The next date that stands out in the engineering history of the New York Edison system is that of resort to high tension transmission and the use of the alternating current for that purpose. In 1896 an experimental station of this nature was installed at Seventy-second Street and Fifth Avenue transmitting current at 2400 volts for the Manhattan station, foot of Eightieth Street and East River, to be followed in November, 1898, by the use in practical work of such a method between Duane Street and Thirty-ninth Street stations. Using the existing underground ducts on Broadway, using three-conductor high tension cable, direct current taken off the downtown busbars at ordinary voltage was transformed to three-phase alternating current by rotary converters, passed through static transformers to raise the pressure, and then by similar apparatus and inverse process brought back to direct current at ordinary voltage at the uptown receiving end, for use by the consumer, he was unwitting that here was the ending of an old electrical dispensation and the beginning of a new, on Manhattan Island.

As with the pioneer arc lamp, one more illustration is now afforded of the swift and enormous changes that sweep over the modern electrical arts—in the supercession of the continuous, or direct, current generator. In 1917, the kilowatt capacity of direct current generators in American central stations was only about 5 per cent of the total. That year the American central stations generated 32,000,000,000 kilowatt hours, delivered over 87,000 miles of high tension transmission lines. The voltage, which on some of these lines is increased for transmission up to more than 150,000 volts, is by transformer modulation brought, if necessary, to 110 volts in lamp or motor on the consumption circuits.

THOMAS A EDISON VISITING WATERSIDE STATION—1902

It is obviously a most tremendous and intriguing chapter of electrical history summed up in these few facts, but that can now be only outlined for the necessary purposes of the story.

Elsewhere in this little volume are given a few simple tables that set forth in some detail the vast generating capacity of the Edison Company and the allied United Electric Light & Power Company, in and on Manhattan, as well as the supplementary and auxiliary apparatus that helps to make service possible and cheap besides dependable and regular. The area thus "electrified" not only includes the central 22 square miles of New York County and 20 of Bronx, but through Allied Companies the remaining 21 of Brooklyn, virtually all of Westchester's 448, as well as of Queen's 121. A noble territory crowded with some 7,000,000 of the richest and most enterprising people on earth, who demand a service that must be the sine qua non in standard. The quality throughout must be uniform, whether the customer is some importer down on Burling Slip, or the remotest commuter, who must receive his unwearied watt fifty miles from City Hall. Moreover, a considerable portion of the energy generated in the plants listed is availed of to supplement the passenger transportation systems of the region; and one sizeable station taken over under lease, is located over in Jersey City for the supply of the Hudson and Manhattan tubes that are part of the "road to yesterday," for persons seeking more restful quarters than the Great White Way.

The totals of those tables are impressive. The maximum kilowatt capacity exhibited is 694,500 which for the sake of convenience the writer will hereafter refer to as 600,000. It is easier to think of such round figures in relation to 7,000,000 population. This immense generating capacity is wholly steam driven. The table shows also the rating of the steam "turbos," and incidentally the capacity of the "Old Guard," the few steam engines of the reciprocating type still remain-

ing for direct current dynamo operation in the Duane Street station; and a few at Kingsbridge under lease for alternating current. Only sixteen engines remaining of a total capacity around 40,000 kilowatts. It can be readily seen how small in the output of a year in a system of 700,000 kilowatt capacity such an engine capacity is; and concurrently, the transition is startlingly set forth, from the old method of steam conversion into electricity by reciprocating engines to the one now all-prevailing and triumphant, steam turbine-generators.

Another table in the rear of the text gives the static transformer equipment of the various generating plants—the "step-up" apparatus by which the current from the generators is increased in voltage for transmission to the various sub-stations, there to be received by other "step-down" transformers and converters that let it down easily to lower grades of pressure for use as direct current over a large part of the area, or as alternating current at convenient consumption voltage in other sectors. Just a word, however, in this connection;—as one contemplates these massive pieces of apparatus doing an immense amount of real hard work in silence without the quiver of a muscle, one sees Rodin's colossal Thinker, and recalls the fine utterance of Mr George Westinghouse, in 1910, before his fellow engineers:—"As an illustration of the wonders of the laws of Nature, few inventions or discoveries can excel the static transformer. To have discovered how to make an inert mass of metal capable of transforming alternating currents of 100,000 volts into currents of any required lower voltage with a loss of only a trifle of the energy so transformed, would have been to achieve enduring fame. The facts divide this honor among a few, the beneficiaries will be tens of millions."

Capacity Sheet, No 5, in the Statistical part of this book, on later pages, is another necessary supplement to the generating table, as it exhibits the vast array of apparatus re-

quired to manipulate and deliver all the flood of current as called for by the customers of the Company—in other words, to break down the gigantic wholesale quantities into such retail parts that no resident on Manhattan Island or the adjacent territory is too small to be served. These sub-stations just about equal in number today the 36 or 38 that Edison had in mind for "little old New York" as he knew it forty years ago, with a population on Manhattan barely one-half of what it is today. Possibly some relation may persist that runs through the requirements as the system and the city, or its population and area, expand together. Looking at the details of the sub-station equipment, it is seen that of storage batteries there are now, after thirty years, no fewer than 50 with a reservoir, stand-by capacity of 435,500 ampere hours at a 1 hour rate of discharge. Of rotary converters, 182 are listed with a capacity of 362,200 kilowatts; and there are 397 static transformers.

A mere catalogue of machinery, a simple table of apparatus, cannot reveal the rationale of even a minor mechanical plant. The great modern central stations, like the ocean liners, or the steel mills, are organisms of a high complexity, whose perfect operation can be traced to adequate conception of the problem confronted and consummate skill in devising the harmonious whole, adapted ideally to the conditions. In a few paragraphs have been presented the steps in the evolution of the New York Edison central stations, and a summing up of the data with regard to their mere physical equipment. There is left for other chapters discussion of various engineering features to include which here would blur and confuse the main lines of the picture, but which considered separately will strengthen the impression that now just as much as when Edison himself forty years ago applied his intellectual powers to the lamp, the dynamo, and all that went to make old Pearl Street a magnificent success, talent of corresponding character is demanded for the design and

operation of the plants that furnish light, heat and power in 1922.

All the foregoing treats of the vital interior organism of the modern central station as illustrated in New York and elsewhere. There is, however, the exterior aspect of such buildings now as typical and distinctive as that of a cathedral; and the architectural elements in the long series of New York Edison plants will also be taken up in a later chapter.

CHAPTER VIII

Expansion of the Edison Network and Details of the Underground System

SEVEN years after the First Edison District of New York went into operation successfully, entirely with underground circuits—the first example of the kind the world had ever seen, a stormy convention of electric light managers was held at Niagara Falls. The noise of it literally rivaled that of the great cataract. The hotel lobbies were surging masses of excited men.

This scene, which stands out vividly in memory thirty-three years later, was provoked by the proposition that the central station men there assembled in their authoritative organization ought to admit that Edison had proved his case, and that a formal resolution should be adopted in favor of placing the wires underground. The subject, like the wires, was very much in the air at the time; a Board of Electrical Control had just been appointed by Governor Flower solely to take down the wires in the city of New York; and it was alleged that an even stronger control of the whole electric light industry was being aimed at by a group of clever manipulators interested in creating conduit systems into which all the wires would have to go.

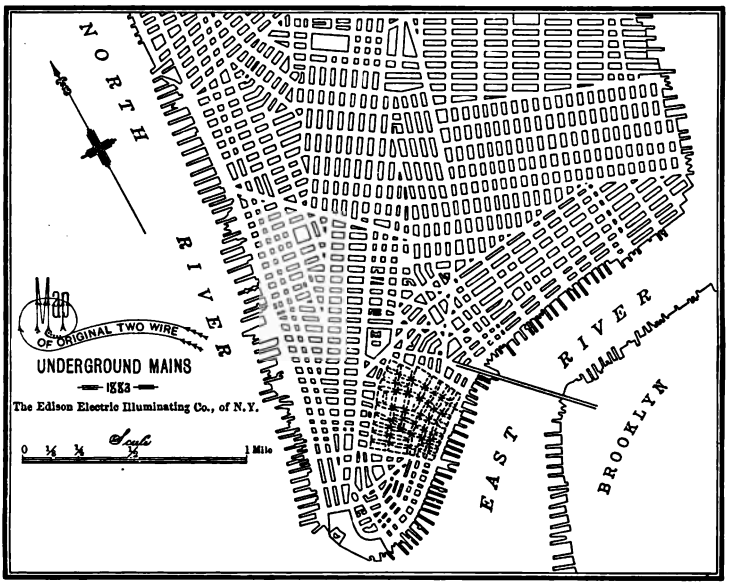
Reference to this little episode is not introduced merely because it was so picturesque and human, but because it illustrates the fact that in winning his case Edison stopped any material extension of his admirable underground system as originally designed. When it was agreed that, as he had insisted, heavily loaded circuits would work underground without danger, the obvious next step was the provision of tubes and ducts in which to place all the wires and cables for every electrical utility. Some of the attributions paid

HEATING NEW YORK BY STEAM
Drawn by W P Snyder. *Harper's Weekly*, 1882

in this volume to the founder of the New York Edison service may possibly have smacked of a desire to lay at his feet all the glory, but the offence, if such it be, must now be added to in the assertion that Edison is the father of all the underground working of electrical conductors in America.

As a matter of fact, the Edison underground system, as applied in several of the largest American cities, was wholly adequate to its purpose. To quote Mr John W Lieb, who more than any other man has had to deal with both the older method and the later ones: "The Edison tube system, aside from its remarkably perfect engineering plans of feeders and mains, sectionalized and multiple-arced, and securing a uniform pressure throughout an extensive network notwithstanding variations in density of territory and fluctuations in load, exhibited a number of wonderfully well-thought out details—simple, intensely practical, and thoroughly effective in operation." Thus crisply stated is the proof of Edison's ability as an engineer, just as the dynamo was proof of his skill as a designer, and the lamp a supreme proof of his mastery as an inventor.

Descending to detail it was pointed out that the Edison tube proper had many good features to commend it, and with its feeder, junction, tee, coupling and service boxes, straight and T-joints, safety catches and other minor parts, presented a truly remarkable aggregation of both electrical and mechanical details. The service and house wiring, cut-outs, fuse blocks and all the imaginable combinations of main lines and branches, the safety catch plugs, circuit switches, key sockets, plain sockets, fixture parts, embodied "an adaptation of means to the end, and all so responsive to every requirement, that it was many years before the industry could show any other devices that were anywhere near to an equivalent." At first, as the historical relics collected for the memorial exhibition will show, there was some crude rough-and-readiness about the wooden blocks and



THE EDISON UNDERGROUND SYSTEM IN 1883

plugs, with their original conical rim and barrel screw contacts—as there was about flexible cords and fixtures for interior use—but the porcelain and glass industries got to work, and soon molded and pressed form were available, as well as shapes in a variety of new insulating materials, extending the old notions of what fireproof equipment should be. Once again, the interaction of allied arts was seen, with consequent higher perfection in each.

But the early devices met the situation, they accomplished the purpose, filled all service requirements, and their fame will never be lessened. Their fragrant memory will remain more particularly with all who worked in the making or installing of the fifteen miles of Edison tube conductors needed for the First District. The tubes were manufactured by the Electric Tube Company, at 65 Washington Street, with Mr John Kruesi as presiding genius over the kettles of

asphaltum and linseed oil. The conductors were half-round copper bars held in place, as to the tube itself and each other, by stout cardboard at first, and later by a twisted rope and cardboard spacing. The pipes were twenty foot lengths into which the conductors, six inches longer, were inserted, with the odorous "compound" forced in for insulation. In one of the operations, the lengths of tubing had to be stuck out of the front window to turn them around; and the whole neighborhood participated in the spectacle and smell. Up to the very last stages of their use Edison delighted in the processes of tube manufacture, for the problems of insulation appealed to his expert familiarity with chemistry. As late as 1887 he is seen discussing with Mr Kruesi the inadequacy of the insulating compound under 1200 volts pressure, and expatiating on the importance of eliminating air bubbles. "Until I get at the proper method of pouring and get rid of the air bubbles, it will be waste of time to experiment with other asphalts." A little later, inventing off hand, in a letter to Kruesi, shrewd schemes for getting rid of those bubbles and holes, he remarked, "Thus you have three coatings, and it is impossible an air hole in one should match the other."

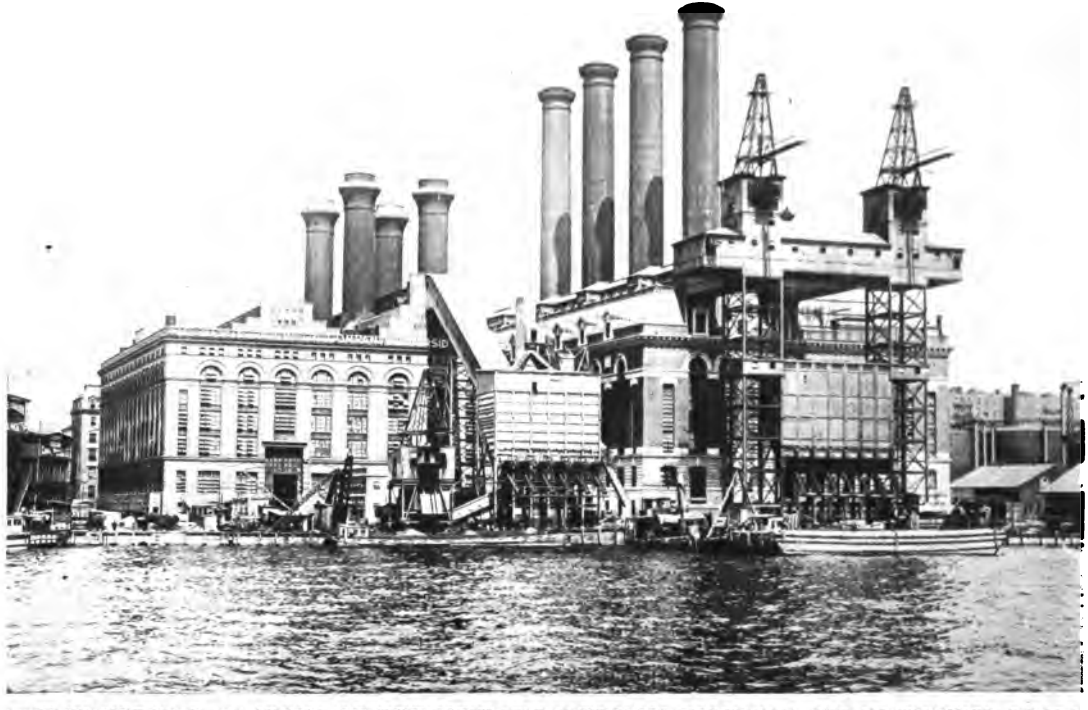
One of the leading engineers of the last generation was Dr Charles E Emery, who, just about the time that Edison was introducing his electric light into New York, was struggling under many difficulties to give the city another pioneer utility of somewhat analogous character—steam heating from a central heating plant. Emery was more successful than Mr Theodore N Vail was in trying to give Boston a hot water distributing system. Misery loves company, it is said, but in the case of Edison, for his own guidance he wanted to know how the other fellow was getting along. The following amusing incident, described by Edison to the writer, is certainly fitting part of these annals of New York: "While I was digging the trenches and putting in the tubes in the several miles of street in the First District, the New York Steam

Heating Company was also digging trenches and putting in steam heating pipes. Mr C E Emery, then the chief engineer, and I would meet quite frequently at all hours of the night, I looking after my tubes and he after his pipes. At the same time that Emery was putting down his pipes, another concern started in opposition to the New York Steam Heating Company and was also working nights putting down its pipes in Maiden Lane. I used to talk to Emery about the success of his scheme. I thought he had a harder proposition than I had and he thought that mine was harder than his. But one thing we both agreed on, and that was that the other steam heating engineer hadn't any chance at all, and that his company would surely fail. If he, Emery, was right the other fellow was wrong. Emery used mineral wool to surround his pipes, which was of a fibrous nature and was stuffed in boxes to prevent the loss of heat and pressure; whereas his competitor was laying his pipes in square boxes filled with lampblack. Before Emery had finished all his pipes and was working in the street one night, he heard a terrible rush of steam. It seems that his competitor had put on steam pressure to test out his pipes. There was a leak in the pipe; the steam got into the lampblack, and blew up, throwing about three tons of lampblack all over the place, and covering the fronts of several stores in Maiden Lane. When the people came down next morning everything was covered with lampblack—and the company busted!"

The cynical comment made at this very time that "some of the electrical companies wanted all the air, others apparently had use for all the water, Edison asked only for the earth," lost some of its sting when all the operating companies had to go underground in imitation of him. A famous and delightful New York Republican politician of the time, Mr Jacob Hess, was an active member of the new commission formed, as already noted, and he once described the avalanche of plans and projects that overwhelmed the body,

especially by those who had patents for sale or wanted to dig "pay dirt" out of the "hole in the ground." The Commission very naturally turned to Edison for his advice. It was terse, simple, and characteristic, to quote Hess: "All you have to do, gentlemen, is to insulate your wires, draw them through the cheapest thing on earth—iron pipe—run your pipes through channels or galleries under the street, and you've got the whole thing done." All will agree that such is virtually the system of the whole city today as it is of many others—with variants in perforated cement blocks instead of the plain iron pipes or terra cotta ducts that can be built up into any required multiple combination to suit service exigencies. A further reference is made later to the New York high tension underground subway system created along these lines.

At any rate, thanks to Edison's prescience, The New York Edison Company faced the new conditions, serenely, safe beyond public criticism. His original plan was to lay the mains in front of the buildings on each block, joined at the street corners into a crib or network; and to supply current to the system of "mains" by "feeders" running from the central station to various strategic points on the network, in order to maintain an even pressure of supply. Of his original "two-wire" system, 4½ miles of feeders and 10½ miles of mains were laid downtown. After the two-wire period, came, as already described, the famous universal "three-wire" system, in which, by introducing a third wire from the dynamo, it was possible by doubling the working voltage, maintaining however the lamp voltage, to greatly decrease the copper necessary to carry the current; and by lessening the "drop" or energy losses, to extend greatly the area of service. All the new uptown district was installed, as it developed, on the three-wire method, not only in the streets, but throughout the interior installations, the lamps being evenly "balanced" on the positive and negative sides with 120 volts on either side of the system, or 240 volts between the "outside" con-



THE WATERSIDE STATIONS OF THE NEW YORK EDISON COMPANY WHICH EXTEND FROM FIRST AVENUE TO EAST RIVER AND FROM THIRTY-EIGHTH TO FORTIETH STREETS

ductors. The annals of the Company show that the old two-wire system disappeared from the roster in 1902. A statement, published by the author, in 1896, says that there were then 203 miles of duct containing 608 miles of New York Edison copper conductor under the streets. The standard sizes employed for mains were 150,000 circular mils, 200,000 C M and 350,000 C M in area. In the mains, the neutral or third wire was the same in cross section as the outside wires; while in the feeders, running from 400,000 to 1,000,000 C M, the neutral wire was one-third the area of the other two. It was all Edison tube as standard, at the time, except some iron-armored Siemens cable tried for feeders radiating from Fifty-third Street, then the Company's furthest north station.

A couple of years later, in 1898, the Company launched out on its high-tension alternating current transmission, with an entirely new set of conditions, and then came the splendid Waterside Station, the first visible exponent to the public of all the sweeping, evolutional changes summed up within its stately halls, crowded with pulsating machinery. The underground system connected with Waterside, in 1902, is typical of all that has been done later, except that the resort to higher and higher transmission voltages has led to the adoption of insulation methods for the cables that involve a degree of refinement and perfection utterly undreamed of even twenty years ago.

The three-phase, 25-cycle alternating current at 6600 volts—now being raised to 11,000 volts—generated at Waterside, was then, as now, distributed to the various rotary converter sub-stations by the underground cables, carried in trunk line ducts. These main trunk lines, as well as any later additions, form part of the general subway system of the Consolidated Telegraph & Electrical Subway Company—the official city subway system for high tension cables. The same general method and description applies to the connections of the plants at the northern edge and tip of Manhattan Island.

The ducts of the Subway Company, residuary legatee of the underground functions of the first Subway Commission of 1888, and its successor The Board of Electrical Control, cover practically all of the main avenues of the city and nearly all of the cross streets on both sides. The ducts, into which the New York Edison cables are drawn, are generally glazed tile laid in concrete. Manholes are provided at street intersections and at other convenient points to permit the drawing in and splicing of cables; with intermediate handholes in the distributing ducts for connections to the individual customers. The earlier method adopted to protect the high-tension three-phase cables at the manholes was a wrapping of asbestos and steel tape and later a cement covering over lattice wrapping.

The first three-phase cables were rubber insulated in the 6600 volt work of the Company of 1898, followed very shortly by the paper insulated, lead sheathed type. These cables are of 37 strands of copper wire, carrying paper insulation of 5-32 inch around each conductor and an outside insulating jacket for the group of three of the same thickness. The leaden sheath is 4-32 inch in thickness. These cables had sufficient capacity to carry a 2500 kilowatt rotary converter, the feeder and converter being operated as a unit. In 1911 came the development of the 3500 kilowatt converter and fortunately at the same time the sector type of cable. This type of cable contained 40 per cent more copper than the round type, but was of the same outside diameter permitting the operation of the new 3500 kilowatt converters as a unit with a sector type 350,000 C M feeder.

In 1921 The New York Edison Company started to change its transmission system from 6600 to 11,000 volts and it is interesting to note that the old 250,000 C M feeder had been designed with such a margin of safety that it was possible to make this change in voltage without making any changes in the high tension feeders.

CHAPTER IX

Some Chief Engineering Features of the New York Edison System and Service

THE power to visualize the future no less than the ability to cope with the present is demanded of the engineer when he comes to deal with the supply of electric light and power to several million people today, whose number may well be twice as great when The New York Edison Company marching on, celebrates the fiftieth anniversary of its hùmble beginning in a little, narrow, crooked street "downtown." All of which may broadly be true in other fields of endeavor, but it is certainly pertinent and justified here as one reads the remark of Mr T E Murray, vice-president, in 1910, about the twin Waterside stations, "Waterside No 1 station was designed to satisfy the steadily increasing load on the New York Edison system *at the rate* then obtaining until 1910, but, *as the construction proceeded it was seen* that even with the increased capacity which was obtained from the generating units the station would be at its limit after the year 1905." He then tells how it was decided to construct a second station at the same center, a location that met the exigencies better than any other spot on either shore of Manhattan Island. This station was therefore planned also to be connected both electrically and mechanically with No 1, since all the problems of safety, continuity of service and flexibility, could be better solved by the close proximity of the stations than in any other way. Thus it came about that Waterside No 1, completed in October, 1901, soon had placed alongside it the noble "twin" Waterside No 2, which was put into regular service in 1906. Even while all this development was going on, internal organic changes were taking place, for in 1912, for example, four of the original 3500 kilowatt generators in

No 1 were replaced by three 20,000 kilowatt turbines, taking up hardly any more space than their predecessors, although at once jumping the total capacity from 14,000 kilowatts, in the old group, to over four times as much—60,000 kilowatts in the new. Later, the remaining engines were replaced by two 35,000 kilowatt turbines, still further increasing the ratio of generating replacement to the original equipment.

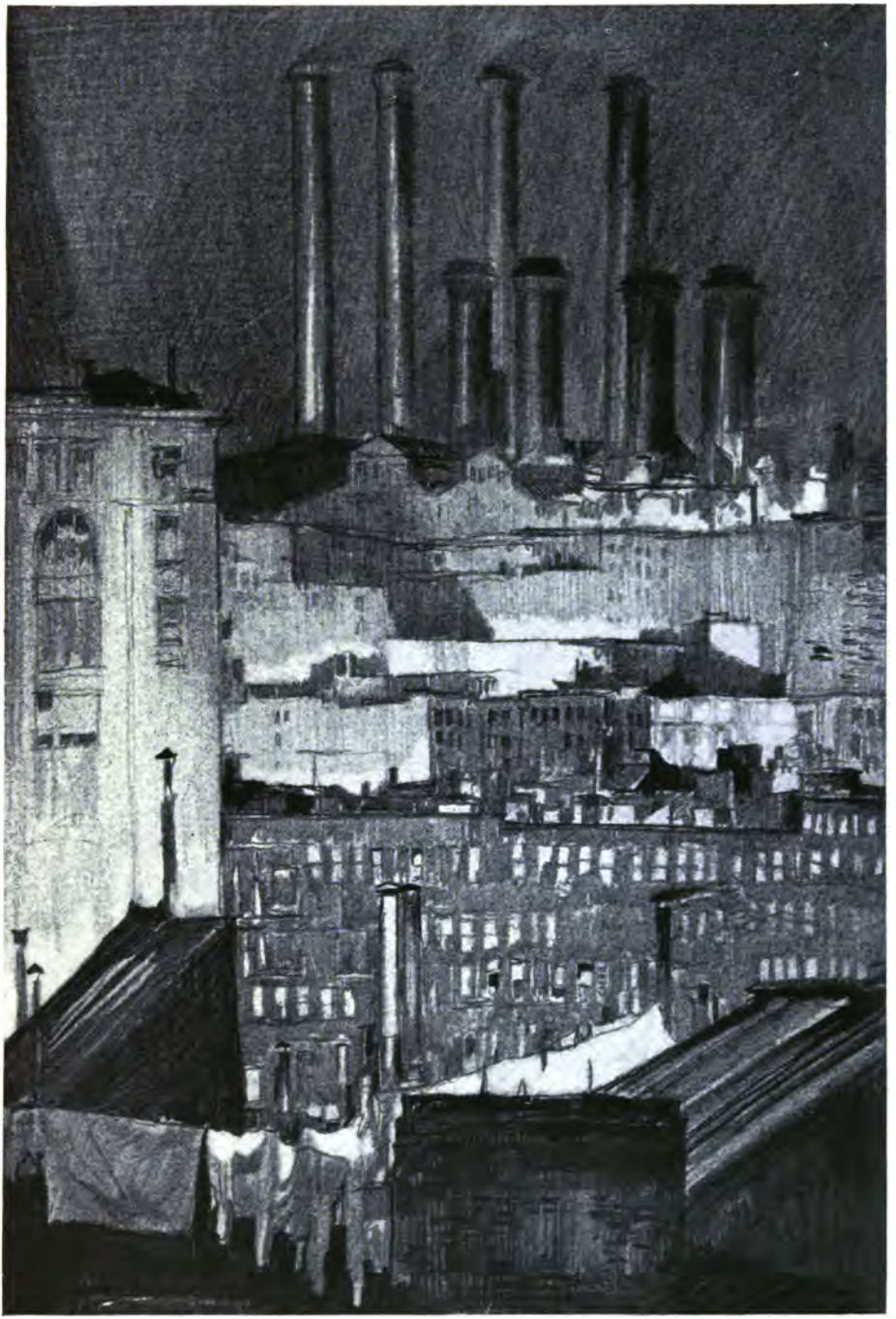
Having thus presented briefly in this and other chapters the engineering theory and philosophy of current generation and distribution by the New York Edison system, the temptation is to touch upon a number of important engineering "high spots," but one is led immediately into a mass of technical detail, which the reader would doubtless not revel in as much as does the expert, already fairly familiar with it. Were such details here and now described in all their ramifications, it would be impossible to stress too greatly the thought, ingenuity and skill displayed in the work, over all of which as when forty years ago Edison wanted as big margins of it as he could then secure, is written the slogan "Service First."

Before there can be any coal handling there must be a coal supply, which in itself is quite as much an engineering question as a mechanical one. A nation that ever since 1917 has been on the brink of fuel shortage needs no reminder of the vital importance of coal. In the central station industry, whose output was nearly forty-four billion kilowatt hours in 1921, of which probably two-thirds was produced by steam, the highest economy of coal and steam utilization is insisted upon.

Many are the vicissitudes to which the central station industry in its amazing growth has been subjected, chiefly because it has persistently doubled itself every five years since Edison began four decades ago. The coal and ash heaps have shared the general tumult, as they left behind the little barrels that cluttered up the area way of Pearl Street. For

instance, the bunkers at the top of Waterside No 2 hold about 1800 tons of coal, or nearly two week's supply; and the tower buckets and elevating machinery to hoist that coal run easily at a rate of over 150 tons an hour. Of similar organization, there are at Hell Gate to handle the enormous tonnage of coal required two coal towers on the wharf, electrically operated to hoist 250 tons per hour, two skip hoists of 200 tons an hour, and automatic cable roads winding around the roof story, of corresponding capacity. Across the Hudson at Shadyside, opposite the Grant Tomb, is a big tract of land bought by The New York Edison Company in 1903, where a huge supply of coal is kept on hand, the yards there having a capacity of over 200,000 tons fed in from the coal hinterland; also there is a coal storage capacity at the Hell Gate station of 100,000 tons. The generating stations consume roughly from 3000 to 4000 tons of coal per day, brought in by barges from the tide water terminals or from Shadyside. At the Watersides, the ashes are handled by an ingenious duplicate conveying system into a pocket and then to scows; but at Hell Gate, by a more recent method, the ashes are flushed by condensing water to a settling tank on the dock, and a crane then delivers them either to auto trucks or to the scows. Waterside No 2 has no fewer than 92 boilers of 650 horsepower each, arranged on two floors, one with 48 and the other with 42. Each of the four lofty stacks, located midway of a boiler row, serves a quarter of the boilers on each floor; whereas the Hell Gate station, for its present installation of half its ultimate capacity, has 12 boilers of 1980 horsepower each, all on a single floor, served by two huge stacks. But only by visiting these stations can any true appreciation of them be obtained.

Turning to the current handling apparatus: conditions and methods as complex as those of dealing with millions of tons of coal are encountered. One of the extraordinary aspects of modern warfare is that a battle firing line may



THE STACKS OF THE WATERSIDE STATIONS, THIRTY-EIGHTH TO FORTIETH STREETS, ON THE EAST RIVER

Etching by E Horter

often be a hundred miles long, while the operative strategic control is many miles back of the front where the struggle cannot possibly be seen. In like manner, the little one-piece wooden or slate switchboard of the early stations has grown into literally a full-sized apartment house, whose tenants are switches and switchboards. At Waterside the electrical galleries mount through seven floors, but they are all within the main power house structure. There is plenty of room for them, for Waterside No 2 has the noble dimensions of about 350 feet by 200, and an area of 67,478 square feet, far in excess of many a famous cathedral or operahouse. But at Hell Gate the development has gone even further, for its electrical control galleries are in a separate seven-story steel frame reinforced concrete building 212 feet by 105. To prevent or frustrate any induced electrical current, the building is so constructed that no two reinforcing bars are in contact, a refinement quite unknown to other architecture. In all these big modern central stations there are, moreover, concrete or brick switching compartments, wherein each switch works in strict solitary confinement. Hell Gate has 1452 such cells. For the cables running in the walls and floors of its switching galleries, there are about 30 miles of concrete duct.

And finally the outputs of all of the mammoth producers of electrical power, the two Watersides, Sherman Creek and Hell Gate with a half dozen of smaller magnitude, are correlated under the direct control of a central head, which brings them into one single great operating system.

To secure the unfailing perfection of service provided means that no detail of equipment, organization or operation can ever be overlooked, from the coal pile, and even the cars of coal at the mines, to the final delivery of the finished product to the proper channels of distribution.

A few pages back, the problems of metering were referred to as a very important part of handling the current generated and distributed by a central station. What is more par-

ticularly in mind is the measurement of the electrical energy delivered to the consumer. Obviously, a competent management will check up very closely the number of units it produces, uses for itself, supplies to its patrons, or is unaccounted for. That is a function of internal economy. The larger and more vital aspect of metering is found in the relations with the public, exterior to the plant. In an article published some eight years ago, entitled, "Commercial Metering of Electrical Energy"; the Company's metering methods are set forth in detail. Some of the more important elements to be considered in the operation of a meter department are noted, viz, the selection of the proper types of meters and their approval by the regulating authority; assignment of the proper type and capacity of meter to the individual installation; a proper system of tests and inspections; inspection on installation; periodic tests; inspection to detect tampering; office test; consumers' complaint test; Public Service Commission tests; method of settlement of complaints; standard organization of meter department; records and statistics. One or two of these divisions fall more directly within the scope of the chapters on rates and public relations, in the present book. But they are all essential features of this general survey which, in itself, gives a brief, swift glance at the outstanding features in modern meter testing and inspection as carried on up to the present moment. Of the meters themselves little need be said here. There are no instruments superior for the measurement of any commodity in large daily consumption, to those employed in the electrical field; nor are there any better methods of maintaining accuracy than are applied to the calibration of such instruments. The public has long since learned as to electricity meters that, as Paul Bourget has said somewhere, there is "no mystery, only ignorance"; and that the principles worked upon are within high school comprehension. Moreover, the acceptability of any meter was long since simplified, by the estab-

lishment of the Code of Electricity Meters developed by the National Electric Light Association and the Association of Edison Illuminating Companies, back of which lies the admirable work of the numerous Public Service Commissions of the country and the splendid organization for any final review and test of the U S Bureau of Standards at Washington. The rules and regulations for the meters in New York City provide for the testing of all and every meter periodically at intervals ranging from six to forty-two months, depending on nature and function, "Supplementing a routine testing schedule such as the above, there may be special groups of meters tested at shorter intervals because an intimate knowledge of local conditions makes more frequent tests advisable, such, for instance, as meters set for emergency, temporary or construction work. * * * Another group of meters which it is advisable to test at intervals shorter than those prescribed by the routine schedule of tests, consists of meters whose monthly registration would raise a suspicion of tampering on the part of the consumer."

The general policy of utmost care and vigilance, emphasizing the fact that every electrical engineer has drilled into him the necessity for exactitude, is summed up in the remark of one of the leading educational authorities in America, that: "Experience in careful measurement gradually teaches us to regard any graduated instrument with suspicion; and so it becomes necessary from time to time to test the accuracy of electric instruments." It is a matter of common knowledge that the resort to the Public Service Commissions by various complainants for supposed inaccuracy has very steadily declined throughout the country, and has been succeeded by a growing appreciation on the part of the public of the high plane upon which the lighting companies have developed the metering of their product, endeavoring to avoid overcharge, inaccuracy and justifiable ground of complaint. In that article cited tables and curves given

show that from 1909 to 1913 the ratio of New York complaints to the Public Service Commission to the total number of meters in use fell from 0.75 per cent on 95,000 meters to 0.18 per cent on just twice the number; and that curve has steadily continued to drop ever since.

Just what all this requires may be gathered from one sentence in the article: "The work involved in conducting as in one case we have in mind, 300,000 meter tests and inspections annually, involves not only the work of the meter indexer and installation workmen, but the gathering, training, maintaining and directing of a complete and efficient organization." Such men are not readily found nor easily trained; in fact, they have usually natural aptitude and enthusiasm. When the late Stephen D Field was in Geneva with the writer he had bought no fewer than fifteen of the beautiful Swiss watches there made. Each had some special feature of skill, finish and fineness; and the worthy nephew of Cyrus simply could not resist the appeal to his Yankee love of exquisite mechanical workmanship, although it kept him hovering on the border of being "stonebroke." He was, in this sense, a typical "meterman," as developed in the meter department of The New York Edison Company, with conscience and conscientiousness equal to that of the meters.

CHAPTER X

Financial Aspects of New York Edison Growth—Real Estate—Insurance

ONE million dollars was a good deal of money in 1882. So it is now, forty years later, after a period of financial, industrial, and economic expansion that carries with it totals and quantities to be expressed in billions. The sum named was the capital of The Edison Electric Illuminating Company of New York, to which The New York Edison Company is the lineal successor. At the time of the incorporation, under circumstances noted in a previous chapter, the young electric lighting industry of the country was so small it was not made a subject to be included in the U S census; and as late as 1890, New York State was the one commonwealth for which even a partial canvass had been made. In that year, the total cost of construction and equipment in the State was $31,183,618. The last bond issue of The New York Edison Company, in 1922, to cover necessary new construction was $30,000,000, instantly taken up by the New York public. In 1902, the electric lighting plants of the whole state of New York stood for $112,998,778 in cost of construction and equipment. The balance sheet of the Company as of November, 1921, showed fixed capital assets, including land, or half as much again as that, namely, $159,855,435. This compares again in a very striking way with the cost of all the central stations in the United States, in 1902, a sum just slightly in excess of $500,000,000; so that in "little old New York," The New York Edison Company by itself now stands for one-third of the total central station investment of the whole United States only two decades ago.

Such figures are impressive in themselves, but their importance grows as one studies the various implications.

The financial ones were admirably brought up a month or two ago by U S Attorney General Daugherty, in some remarks which embodied the hope that the old days, when public utilities were subjected to partisan political agitation, had passed, as well as any unjust expectations and demands either by the public or the utilities. He expressed the general amazement that so much should now be at stake. The investment of the light and power companies is already, he said, five billions of dollars—ten times as much as twenty years ago. The gross annual income is $950,000,000. There are about 1,600,000 holders of the securities of some 5000 companies. The banks of the country have invested in such securities to the extent of $1,700,000,000. As there are 29,000 banks with 27,000,000 depositors, an average per capita investment is seen of about $63, for about half the adult population of the United States. Moreover, to quote Mr Daugherty: "The life insurance companies of the country, which invest the savings and care for the aged, as well as for those who have a claim upon our bounty, have also invested, I find, $300,000,000 of their funds in such securities." To all of which it may be added that figures compiled by the *Electrical World*, in 1920, showed in that year no fewer than 8,520,400 central station customers, a number which in round figures, but quite accurately, may now be placed at 10,000,000. Tennyson had a fine passage about the throne of England being "broad based upon the people's will." A poet might well be moved to verse in contemplating an agency for public service which barely existed before old Pearl Street forty years ago, but is now broad based upon the people's consumption of electricity. A banker may well see security in an investment that, established barely four decades ago, now has as customers much more than half the families in the towns and cities of America; with every prospect of adding pretty well all the others by 1925.

Now the very interesting fact about all this is that these

results have been so largely achieved in Edison's way; and that the great protagonist and exemplar of that way has been The New York Edison Company. A few statistics are now presented with regard to the finances, real estate and other elements of its make-up, as distinct from the physical plant and equipment. The figures in the balance sheet submitted to the New York Stock Exchange at the end of 1921 for the listing of the $30,000,000 first lien and refunding mortgage bonds, showed debt liabilities of $51,087,965 of which $38,080,109 was funded debt. There was also an authorized issue of stock of $87,145,300 all held by the Consolidated Gas Company of New York. The total under the head of liabilities was $205,953,847. The asset side of the balance sheet showed in fixed capital assets, land, plant, etc, a total of $159,855,435; bonds and stocks of affiliated companies, of $26,829,270; in accounts receivable, $9,171,802; material and supplies at cost, $4,593,364; Government bonds, $4,343,200; cash and some miscellaneous items of $1,160,768. The rate of 7 per cent dividend has been maintained since 1915, and the record of dividend payments goes back to that first $1 in 1885 out of the earnings of Old Pearl Street. Reference may be fitly made here to the balance sheet of the Allied United Electric Light & Power Company as the two companies must be considered together as a unit in connection with their service to the New York public.

The United Company alone shows total assets of $48,486,-702 and a gross earnings for the year of $8,194,428. Some idea of the United properties may be formed from the fact that into its splendid Hell Gate plant, the finest in the world, the very latest expression of the central station art, the sum of $20,000,000 has been put with half of its proposed ultimate capacity.

The question of financial and physical maintenance of a public utility property is always of interest, and, as is well known, quite often constitutes a problem for the various

regulatory bodies as well as the companies, which long since emerged from a regime when the provisions necessary for reserves, retirements and upkeep as a financial organism were far less well recognized and enforced than today. In this connection, therefore, as well as for its own significance as an operating item of fact, it is interesting to record that from 1916 when the kilowatt hour output was just about 856,000,000 units it ran up to 1,278,000,000 in 1920, and it reached in 1921 a grand total of 1,474,000,000. It is obvious from some of the figures given above, that the Company earned in 1920 the modest average sum of less than 5 cents per unit sold and derived the even more modest net income from that of about 1 cent. Ten years ago, the rate had been worked down by steadily increasing efficiencies to an average of somewhat over 6 cents per unit; but, in 1882, when the public rallied gladly to Edison's new standard of illumination, it had paid with alacrity several times the above amounts per kilowatt hour, which was then made as a charge of 1.2 cents per 16 candle power lamp per hour. The kilowatt unit is used advisedly in such comparisons, as it was not until 1890, just when the scientific world adopted it as a new unit of energy more universal now than the horsepower, that the New York Edison system, ever swift to line up with and lead new practice, put the kilowatt hour as the future basis of all its economics. Of that a little more hereafter in dealing with the topics of rates.

It is incidentally mentioned, in the official documents to the Stock Exchange, at the beginning of this year, that the Company's property under the mortgage consisted of no fewer than 89 "parcels." There lies before the writer a list of 48 parcels acquired since January, 1903; and when merely one of these is tersely noted as "block, Thirty-ninth to Fortieth Streets," it is realized that in many instances one is dealing with transactions of tremendous magnitude, and with operations that must be carried out with as infinite

care and good judgment as are the decisions affecting the engineering features and mechanical details. It stands to reason that by virtue of its real estate footing in New York City, the Company has a very large stake in good city government and management. It could not, indeed, be otherwise. The reflection is by no means new here that a central station public utility is in a most extraordinary manner knit into the inmost framework and structure of a great city, as solemnly pledged to be part of it as the very rocks and soil. Manufacture shifts its local habitation ruthlessly over night. The dweller in a Manhattan flat today pays taxes next year in Westchester. Even a harrassed trolley line can take up its road bed and walk away. That the personal element enters sometimes in a way little suspected is best illustrated in a very funny story once told the writer by Edison. The young inventor was beginning his wonderful career of invention in New York, but found like other manufacturers that there were advantages sometimes over in New Jersey, so he had a shop in Newark. "When I moved to Menlo Park, I took out only the machinery that would be necessary for experimental purposes, and left the manufacturing machinery in place. It consisted of many milling machines and other tools for duplicating. I rented this to a man who had formerly been my bookkeeper, and who thought he could make money out of manufacturing. There was about $18,000 worth of machinery. He was to pay me $2,000 a year for the rent of the machinery and keep it in good order. After I moved to Menlo Park, I was very busy with the telephone and phonograph, and I paid no attention to this little arrangement. About three years afterwards, it occurred to me that I had not heard at all from the man who had rented my machinery, so I thought I would go over to Newark and see how things were going. When I got there I found that instead of being a machine shop it was a hotel! I have since been utterly unable to find out what had become of the man or the machinery."

FORTY YEARS OF EDISON SERVICE

The modern central station cannot in the very nature of things fold up its tent and steal away, but is a fixture. It never has but one slogan of loyalty, and that is dedicated to the community it serves, of which it is an integral part, and with whose intimate fortunes it has elected to stand or fall. Even in its contractual relations, of however secure a character, must run recognition of this fact by both parties, toward which happy appreciation ever tends the aim of every good citizen of beloved "old New York."

The directors of The New York Edison Company as this goes to press are: Nicholas F Brady, George F Baker, George B Cortelyou, Lewis B Gawtry, John A Garver, Donald G Geddes, John W Lieb, Thomas E Murray, Edgar Palmer and William G Rockefeller.

The officers are: Nicholas F Brady, president, Thomas E Murray, vice-president, John W Lieb, vice-president, Frederick Smith, treasurer, David Darlington, assistant treasurer, Walter Neumuller, secretary, Frederick W Jesser, assistant secretary, H M Edwards, auditor.

CHAPTER XI

Relations with the City Street Lighting— High Pressure Water Supply

NEW YORK CITY is physically, more largely the creation of Edison than of any other living man, besides which for half a century he has lived and moved among its inhabitants more than among any other group of people. Many a New Yorker has seen the quick twinkle of those eyes and felt the strong grip of that expressive hand since, a struggling young telegrapher, he drifted into town one morning, in 1869, on the Boston boat, much as penniless young Benjamin Franklin, roaming also far from the Hub, landed hungry just two hundred years ago in Philadelphia, to the upbuilding of which great city he too contributed nobly creative work. One can hardly think of a public utility service to whose proper functioning Edison has not lent a hand since

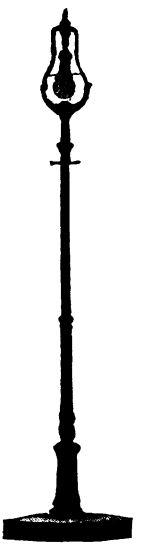
in those dim old "Black Friday" days of the Gold Panic he restored to the paralyzed brokers of Wall Street their dislocated "ticker" central, with a few deft touches. Next to the inventive powers of the first Franklin and of the latter one, whom New Yorkers have watched at close range for fifty years, come their splendid virtues as citizens, printed deep in the institutions they helped to found. Some day the opportunity will present itself to a future historian to dwell upon the parallel lives and achievements of the man who first snatched the lightning from the skies and he who later is still taming it to multifarious benefits. Meantime, as one hears impatient comments on the famous questionnaires or notes, scathing criticisms on quite revolutionary financial plans for currency,

the thoughts of the writer go back involuntarily to the equally prolific mind and altogether unlimited scope of investigation indulged in by the Sage of the Schuylkill as his curiosity ranged over every topic to which a human intellect could be addressed. It is just that way mankind arrives at such inestimable boons as Franklin stoves and Edison lamps.

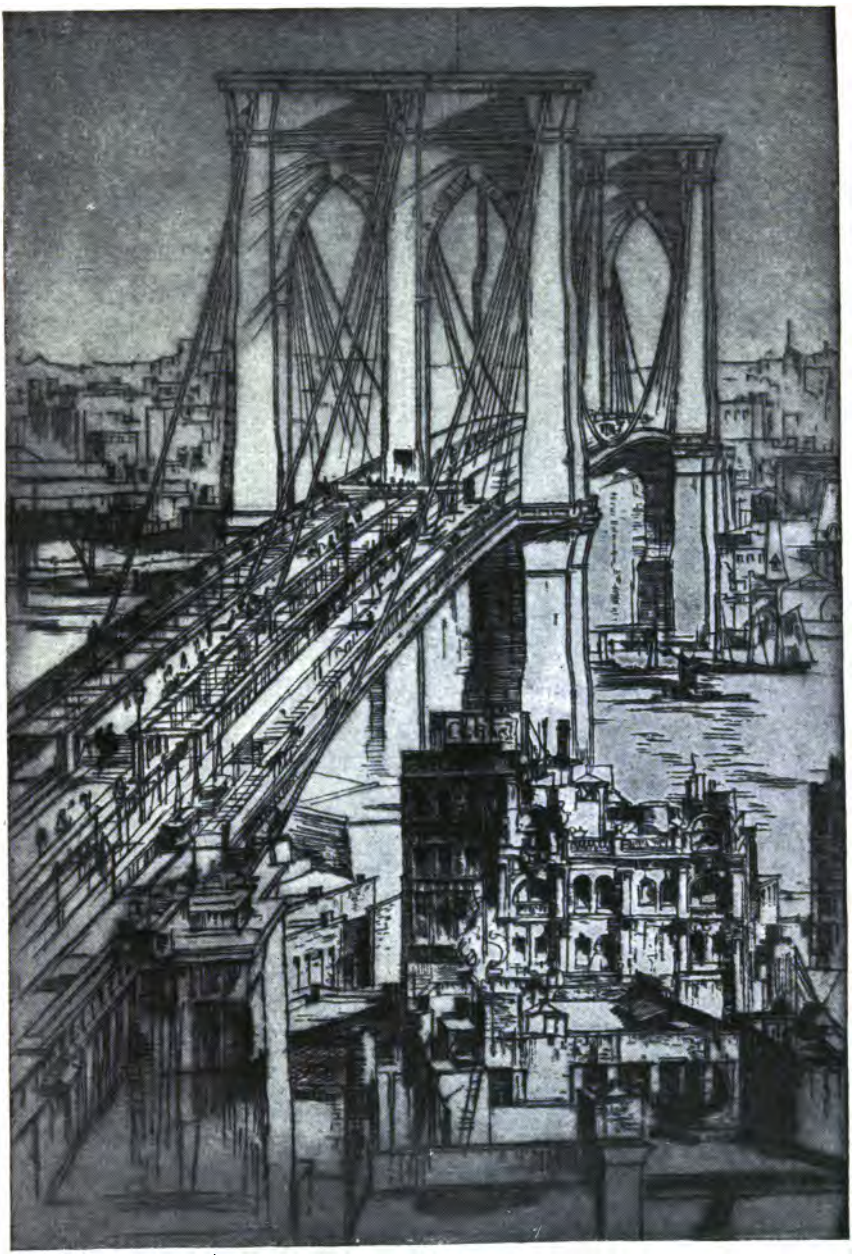
One of the queerest censuses ever taken was carried out in 1882 in old Manhattan when the great inventor was laying broad, deep and strong the foundations of his greatest organic creation, The New York Edison Company of today. His own statement about it lies at this moment before the eye: "I had a great idea of the sale of electric power to large factories, etc, of the electric lighting system; and I got all the insurance maps in New York City, and located all the hoists, printing presses, and other places where they used power. I put all these on the maps, and allowed for the necessary copper in the mains to carry current to them when I put the mains down; so that when these places took current from the station I would be prepared to furnish it because I had allowed for it in the wiring. There were, I remember, 554 hoists in that district. In some places, a horse would be taken upstairs to run a hoist, and would be kept there until he died." What a lovely glimpse of contemporaneous New York, with incipient "Ls," no "Tubes," no skyscrapers, no electric elevators, no incandescent lamps, no electric motors, no electric vehicles.

It would be difficult, indeed, to enumerate, or delimit, the relations through which the City of New York comes into touch with The New York Edison Company. To traverse the subject would be to review the functions of almost all the city departments, besides which it has direct relations with many of the state departments. In New York State the public utilities such as The New York Edison Company are all under the supervision of a Public Service Commission, of which there are usually one for each commonwealth. It

would be rather difficult to find an element of management, or even of operation, where the public is directly concerned, that does not come within the scope of these public service commissions, in place of the earlier popular but now unfashionable doctrine of *laissez faire, laissez aller.* If there is one dictum that the modern utility has to keep in mind it is: "Watch your step!" for there are keen bureaucratic eyes watching it. The broad sweep of all the modern policy of administration through boards of national and state control is perhaps hardly yet seen at its full; but it is at least recognized as infinitely better than the state ownership and operation which during the "late unpleasantness" went into the debacle of proved incompetency and bankruptcy. Today most of the leading European democratic states are yearning to wash their hands of all management of private enterprise and coming to the saner American method well illustrated in the practice of New York State.



Meantime, "we settle it as we go," as the old Latin tag had it, and The New York Edison Company can certainly refer with some self-congratulation to the long record of its harmonious relations with the State Public Service Commissions, in translating their edicts into living rules of corporate conduct, whether they affect sets of accounts, dealings with the public, or engineering practice. But when that is all nicely disposed of, there is still the city administration to confront with its fluctuating, ever-changing personnel and politics, and also a continuing Department of Water Supply, Gas and Electricity. Here, again the relations of the Com-



BROOKLYN BRIDGE
Etching by E Horter

pany are most amicable; but over and beyond all that are the commercial connections with practically all of the departments of a city whose annual budget runs to a total of $350,000,000, and which necessarily buys large quantities of light, heat, and power. Fortunately, a tendency that at one time manifested itself to indulge in an expensive isolated plant for every municipal institution or building has died away before the repeated proof of the excessive cost of such an indulgence to the taxpayer; and the result is that yearly the New York Edison service becomes more and more an economical feature in reducing the expense, while adding to the benefit of the vast group of humanitarian agencies maintained by a large-hearted city for the welfare of its sick, halt, and lame, its deficients and its children. In this chapter, however, note will be made only of two leading contractual services to the city—the street lighting and the high pressure water supply for fire purposes.

The whole history of electric street lighting has been brilliantly illustrated in New York City. The first long chapter of the arc lamp may now be regarded as definitely closed, but a second, stretching on into the indefinitely remote future depends on its victorious rival—the incandescent lamp—proved after long years of slow approach as a worthy successor, and very often occupying the same posts and fixtures. The New Yorker does not have to be very old to remember tall towers standing in what were then "uptown" parks, and shedding from the giddy altitude of 160 feet the white beams of clusters of Brush arc lamps over the area between Union and Madison Squares. Through a long period, the principal New York avenues were lighted by the old series arc lamps, then in part superseded by the enclosed type of arc lamp. Each lamp was rated as equal to three policemen, and they did add immeasurably to the safety of the life and property of the citizens. All that lighting was done by a succession of arc lighting companies long since vanished, whose

functions were gradually taken over by The New York Edison Company and its Allied Electric Companies.

The inheritance of the New York Edison system from the prior arc regime must here be catalogued and summarized, as the arc lighting art still continued its own overlapping career, just as an earlier civilization often lingers in a later one. In 1880, the general type in use when the Edison lamps first put in an appearance was a 9.6 ampere "2000 candle power" arc in a clear globe. Then, in 1895, came the "enclosed" arc of 6.6 amperes in an opal inner globe and an outer clear one, cutting the lumens per watt at least 50 per cent. It won out even in spite of that handicap because of its greater steadiness and because one trim of carbons would carry it for 90 hours. But soon the irrepressible incandescent lamp, now with metallic filament and gas-filled bulb, began to develop an efficiency that made it possible to substitute it lamp for lamp for the arcs. Hence it is convenient now to retrace one's steps hurriedly over the thoroughfares on which with all this arc lamp paraphernalia the New York Edison system has "blazed its way,"—and take a glance at the lamp posts, "sentinels that bar the night."

The first arc posts were commercial enough in all conscience, but as early as 1892 the "Edison touch" was seen, for in that year Fifth Avenue was lighted by The New York Edison Company with artistic posts, a twin fixtures carrying two lamps. These were made by the Bergmann Company for the Columbus Celebration, on plans developed under the direction of Mr R R Bowker, then vice-president of the Edison Company. Gen L T Collis, Commissioner of Public Works returning from a trip abroad said: "No street lighting in Paris or

London excels the Edison lamps for beauty and illumination." Individual or single arc light posts still continued, however, especially with the coming of the enclosed arc lamp, of which the Company had at one time in use some 46,000. In 1904, the fundamental change was made unifying the source of current supply for all the arc lamps in Manhattan; and thereafter for several years the multiple enclosed lamp was generally used. Moreover, the arc lamp was meantime adopted by the municipal authorities for buildings wherein large areas had to be effectively illuminated, notably the great armories of which the metropolis on Manhattan is justly proud.

The New York Edison Company long since reached standards of high artistic excellence in its public lamp posts as any one traveling the streets may see for himself, but it is not perhaps generally realized that the policy thus developed dates back at least twenty-five years. A report of the old Edison Electric Illuminating Company of 1897 says, for instance: "Development of enclosed arc lamps has made possible a similar remarkable development in low-tension street lighting. After a careful collection of views and plans of arc lamp posts used in various cities here and abroad, the engineering department designed a new form of post for city lighting, of artistic pattern. This has met with general approval. This post bears on its base the arms of the city and the seal of the Edison Company, and is surmounted by a graceful curve in place of the awkward yard arm." But as soon as the incandescent lamp was ready for street service, it was taken up, and other decorative fixtures not less beautiful than the greatly admired "Bishop's Crook," were developed for the parks and parkways, and with these for a beginning no fewer than 4000 tungsten lamps had been added by 1912. The total number of electric street lamps in the boroughs of Manhattan and the Bronx now served by The New York Edison Company and Allied Electric Companies reaches a total of 30,000.

In view of the fact that the volume of light from "signs" on some New York thoroughfare is so great, it has been seriously proposed to leave to it local street illumination and turn out the city lights at such points. It is quite pertinent, therefore, to interject here a few remarks about the sign lighting done by The New York Edison Company. The "Great White Way," where sign lighting has reached its peak, is known all over the world as the nickname of the theatrical section of Broadway. No book of travel by visiting foreigners is without its reference to the brilliant, fantastic illumination with which New York nightly throws her own rainbow aurora borealis into the skies. When some one spoke of the magnificent decorative illumination of the Buffalo Exposition with his lamps in 1901, Edison took his bowler hat—pretty capacious, it is true—and said that all the carbon filaments doing it could be put in that container. Such container would amply hold all the tungsten filaments in the Great White Way. But to visualize those fragile filaments there must be thousands of kilowatts of Edison service.

Fires are also among New York spectacles, alas bringing loss and desolation. In 1920, those fires were 14,628 in New York City, and the direct loss was $18,806,908, the indirect loss being incalculable; and the worry of it is that while the number has been greater in other years, the value of the loss mounts steadily, and is 100 per cent higher than ten years ago. One sometimes thinks that words such as "fireproof" and "inflammable" need new definition, but rewriting a dictionary is slow work, and meantime the destruction goes on, despite the efforts of the New York Fire Department and the insurance companies to check it, and lessen the fine for carelessness that now amounts to 10 per cent of all the new annual building construction in the city. No city can boast of a more competent, efficient, brave and progressive Fire Department than New York with its rank and file of 6000 men in 95 highly-trained, well-equipped fire engine compan-

ies, and a flotilla all its own operating along the extensive river fronts. Back of these regimented firefighters lies the superb water supply of the town draining two great watersheds to the north from which 600,000,000 gallons can be drawn daily throughout each year. But all this water and all this human skill has been found inadequate to cope with modern fires of magnitude or safeguard against widespread conflagrations such as in the past devastated large areas of valuable property. The first little fire engine brought from England by sailing ship, in 1731, and worked by hand, had to get its pressure from relays of volunteer "vamps." Just as the crews of pumpers were replaced none too soon by steam fire engines, so now the modern Fire Department of New York City has from the New York Edison system at instant call a high-pressure fire water supply service of inestimable value, at an absurdly small cost. It is probably not generally known that the high-pressure electric fire service system on Manhattan Island covers the territory bounded by Thirty-fourth Street, Madison Avenue, Twenty-fourth Street, Lexington Avenue, Fourteenth Street, Third Avenue, Bowery, Houston Street, East River, Battery, North River. At Gansevoort and West Streets and at Oliver and South Streets, are strategically located two pumping stations, each of which has six huge electrically driven centrifugal pumps. Either fresh or salt-sea water can be used. With a powerful motor behind it, each pump can deliver 3000 gallons a minute. What this means is that the two pumping stations are the equivalent of fifty fire engines. About 128 miles of water mains constitute the distribution network, the mains ranging from 8 to 24 inches in diameter, leading to 2700 four-nozzle hydrants. The pumping plants are, of course, closely tied in electrically with the New York Edison generating plants and sub-stations; and some 700 telephones communicating with Fire Headquarters and the Edison system, hold the service at instantaneous beck and call.

Sufficient power is at all times held in reserve, by the electric company, so that by closing the switches at the pumping stations the pumps can be immediately operated at full capacity. In a recent fire the demand at the pumping stations went to 5800 kilowatts, amounting to 8000 horsepower, which is several times the entire capacity of the average central electric station of the United States. The confidence of the Company in its ability to provide this service with absolute reliability is reflected in the quality of its general service and is indicated in the contract with the city for the service wherein a penalty of $400.00 per minute is imposed for each minute of failure to provide service after three minutes.

CHAPTER XII

Relations with the Public and Public Service Commission—Rates

IN the old Pearl Street days, Edison gloried in censuses. He wanted to know. They call them "surveys" now, but the investigator gets off at about the same place. Mention has already been made of some of these early efforts to size up the community, including even its old horses in elevator shafts. Here is another Edison-like glimpse: "It is true that Sprague figured out mains for us, of new stations, while he was at Brockton, on a new mathematical basis: but we already had a good system of determining the size of the mains and of laying them out in miniature in German silver wire. We made a complete survey of a place before figuring them out. This system was so perfect that we could go into a man's store and say: 'Your gas bill in December was $62.40!' When he looked it up, it was usually within 5 per cent of it. We sometimes found that our estimates were too small, and I soon discovered the cause of this. We went to a place on Sixth Avenue. The man's bill ought to have been $16. It was $32. We took a delicate meter up there, and found that there was a leak which had been going on for fifteen years."

Under the direction of Mr Arthur Williams, general commercial manager of the Company, another survey has just been completed, comparable in scope and importance with the "vital statistic" ones of the National and State Governments. It reveals a lot, explains a lot, suggests a lot, and its data may be said to carry the germs of future corporate policy in dealing with the public.

Manhattan has not far short of 90,000 buildings today, but, such is the trend of the times, only one-third of

these are single family dwellings; although that is still a large proportion in view of the tendency of New Yorkers to become "cliff-dwellers," residents in lofty apartments and tenements. Moreover, it might be that in this day of the kitchenette, and of absentee, retired domestics living on their incomes in Europe, the vogue of electrical apparatus in the apartments would be much more pronounced than in individual homes. Such is broadly the fact. A survey made of one of the new apartment houses uptown develops the interesting and significant fact that the electric appliance load there exceeds either the lighting load or the "power" load, such as elevators or water pumping. It was found that in this building the New York Edison lighting duty was 114 kilowatts; the total power load was only 128, but the total load from electrical appliances reached the extraordinary figure of 148 kilowatts. Such a revelation does not "give us pause," but stimulates to further propaganda. What would be the appliance load for the whole city on equivalent terms? In this building there are 3363 lighting sockets and 385 outlets in baseboards, walls and floors. In a single apartment, however, it ran to 43 lighting sockets as against 21 wall base outlets. The average in the smallest apartments was as 4 to 1. Suppose even that ratio applied the city over.

This is all intensely interesting, especially as it is remembered that when Mr Edward H Johnson began his bold campaign for the "Electric Home" forty years ago, with brilliant examples on Manhattan and at Greenwich, Connecticut, not even yet surpassed, he was without one single appliance "made for the trade," or for the public. Domestic electricity was a terra incognita, but today hardly a wired American home is so humble as to be without one or more of the five hundred clever bits of electrical hardware that justify to the average home-dweller the assertion of the philosopher, "You were made for enjoyment, and the world is filled with things you will enjoy." Of some of these myriad ap-

pliances, the relative popularity is brought out in the survey. Although the apartment house has its own semi-electric hotel kitchen, the tenants had 125 electric cooking devices, from large ranges to toasters. There were seventy-four grills and small stoves, two egg boilers, three large stoves, two hot plates, one waffle iron, twenty-three percolators, and eighteen toasters. It is odd that only one heating pad appeared on the list. Similarly, only three hair curlers, two hair driers and one vibrator are mentioned.

Turning to useful articles that are remote from personal adornment, it may be noted that one of the ranges has a capacity of 6500 watts, and two of 4500, and so on down to ten of from 1300 to 1500 watts. Then there are dishwashers, knife cleaners and sharpeners, two electric washing machines, one electric ironer, and, marvelously, only one lonely electric sewing machine. One of the larger apartments, as self-contained as any high-grade residence, had a practically complete equipment including washing and ironing machines, electrical refrigerator, vacuum cleaner, and exhaust blower in the kitchen, with all the smaller articles.

This summary is not presented here merely as a glimpse at the electrified domestic economy of modern New York, nor to give an inventory of the consumption devices other than lamps in large use, nor to illustrate how infinite is the usefulness of the protean servant of everybody—but chiefly to emphasize the genuine impossibility of now metering current as it was first done in terms of a 16-candle power lamp hour. Edison in the early days had a preference for selling light by the lamp hour rather than electrical energy by the kilowatt hour; but there is no meter, and never will be one, that can differentiate between the employments of current, even if they were roughly grouped into classes, to which a sliding scale might be applied. The nearest approach to anything of the kind is seen in the New York Edison rate schedule, and a few words may now be profitably devoted to a topic which

is as large and important as any other over which this "survey" of the New York Edison has ranged.

Just as there has been development and improvement in the mechanical and electrical resources, so has there been constant broadening of the policies of the Company, as it has grown in size and importance in the service of the city. In the best of present-day engineering practice, one finds the underlying principles of Mr Edison's original work at the Pearl Street Station. So may be found today, in the Company's conception of its obligations to the public, a continuance of principles recognized and adopted by Edison in his larger conceptions of the public service, forty years ago. Then, as now, the first thought was service, good service, at fair prices, available to all, with a uniformity of standards and terms, then recognized as principles of business conduct by Edison and the group of men associated with him, as they are today recognized and accepted throughout the land, and in fact throughout the civilized world where public utilities are available to the people.

One of the indelible impressions left by Mr Edison and the men whom he selected to carry on his work from the beginning, is that of unfailing courtesy and consideration to those with whom they come in contact, whether subordinates in the service, or the general public. Thus, courtesy in the Company became an established habit, and, in the early days of the Company's efforts, undoubtedly, had much to do with its rapid growth and development. Edison himself, innately courteous, was ever a "good mixer"—likes folks. Unfailing courtesy was recognized as one of the Company's obligations to the public, and very early in its career a rule was adopted that all employees should show the same degree of attention and courtesy to the smallest customer that would be given to a director of the Company. No call for service was too small, or seemingly unimportant, to be neglected or ignored; no call for service demanded so much of inconvenience or

attention, even under adverse conditions, as to be in the slightest degree neglected. Electric service, in such a city as New York, must be continuous throughout the day and night and, whenever called for, regardless of cost or Company or employee convenience, is given with immediate and adequate response. This has ever been one of the guiding principles of the Company.

From its earliest days to the present time, the Company has never failed to appreciate that the most priceless possession of a public utility is the good will and favorable public opinion of the community it serves. With each passing year, the importance of public sentiment in the control of all affairs, private and public, national, international, has shown an enormous appreciation. To such an extent has developed the power of public opinion in the decision of public questions, that it is not an exaggeration to say that no utility can be today successfully conducted without a substantial measure of public approval. This pertains not only to sentiment on the fairness of rates and the character of the service, but to the consideration accorded to employees, and to that enormously larger, heterogeneous audience of which the community itself is comprised. This is one of the accepted maxims of today, and it is gratifying that this Company, the first to demonstrate in the largest sense the practical application and the great public usefulness of Mr Edison's electrical work, adopted these principles. Their earlier suggestion and practical adoption were just as much a part of the epoch-marking system of lighting that Edison devised as was the system itself in its mechanical and electrical application.

In the light of progressive utility management of the present-day, it may seem almost trivial to mention rules which call for absolutely truthful statements to customers regarding their meter readings and bills, and other matters pertaining to their services; or to speak of the adoption of

THE NEW YORK SKYSCRAPER IS A BUILDING CLOSELY ASSOCIATED WITH THE DEVELOPMENT OF ELECTRICAL SERVICE

Etching by E Horter

the principle that for like service under like conditions, like rates must be uniformly made; or to note that politeness and consideration must begin with the office boy and with the least conspicuous of the Company's outdoor representatives. Indeed, to refer to these features of public service today may seem redundant, and yet it is with great satisfaction that the Company points to their adoption as matters of policy from its pioneer days.

Again, in the matter of the education of employees, today so almost universally provided for in the large establishments of the country—and yet the Company recalls the time when its own schools in technique, beginning with Johnson's little classes for house wiremen—in accounting, and commercial education, were new and novel, and without precedent amongst the utilities anywhere. Remembering that the men in charge of the utilities, to a very large extent, have grown up from the ranks, and were at first largely drawn from artisans who had been taught the mechanical trades, with better knowledge of machines made of metals, than of human machines, made of flesh and blood, beings sensitive to neglect or indifference, it can be well understood why so much of an adverse public opinion was usually created in the earlier days of some of the utilities. It was not that the men placed in command were unanxious to serve largely and well, but that their vision was limited to the four walls of their stations, or the outlying limits of their distributing systems, and the solution of pressing mechanical and electrical problems. They felt their obligation to cease with the development and the delivery of good service, with little, if any, of the human element involved brought to anything near a like condition of development and perfection. It is, of course, generally recognized today that the public intercourse of our utilities calls for a mentality and personal development in keeping, and comparable with, the very best engineering and technical skill. And once again, it is a matter

of gratification that in recognizing these conditions and the comparative need for the "trained mind" in every branch of the utility service, The New York Edison Company has been many times a pioneer in hitherto unexplored fields of public service development.

In such a city as New York, security of service and unlimited sources and resources behind it, are of greater importance than the mere question of the cost of the service. Regardless of cost, no element of security can be omitted. Considerations are involved which far outweigh any question of expense. Examples are found in the illumination of places of amusement where fire might mean panic, serious accident, and even loss of life; or in the elevator service of the larger buildings of the city, where any failure at all would cause serious annoyance, and repeated failure would so greatly mar the standing of the building in the eyes of its tenants and the public that other methods of "vertical rapid transit" would have to be adopted. An example is seen again, in the illumination of the streets at night, where failure of the service would lead to great increase in crime, and even to loss of life or limb. It is in recognition of these considerations as a part of its obligation to the public that the Company has sought to provide the last degree of security, mechanical and electrical, in generating stations, sub-stations, and the underground system, and in the development of its personnel to the highest degree of mechanical, electrical and scientific attainment. No expense has been too great, no detail too trivially small, to call for the highest attainable degree of perfection in every department in the recognition of its public obligations.

As important as are all the other considerations entering into a broad public policy, the question of rates has never been neglected, and its treatment constitutes a bright chapter in the history of the Company. At the beginning, Mr Edison adopted a rate which was fairly comparable with the

cost of gas, as then established. In those early days, the term used with the customer was the lamp hour, not the kilowatt hour, which was not adopted until about 1890. Discounts were allowed for each payment, and in some instances special contracts were made in recognition of the importance of larger installations, for which schedules had not been established. Prior to September, 1902, the rates to small customers approximated, on the average, 20 cents a kilowatt hour, or something, perhaps, in excess of that figure. The price included the supply of incandescent lamps, for which the cost was in the neighborhood of 1 cent a kilowatt hour. Such discounts as were then allowed were based upon the amount of the bills; but as these discounts did not begin until the monthly amount reached or exceeded $100, the small customer, and for those days even the comparatively large consumer, paid, as indicated above, in the neighborhood of 20 cents a kilowatt hour. Even this price, which in these days may seem very high, led to very little complaint. Electric light was recognized as constituting a marvelous advance in the science of illumination. It possessed many elements of advantage, some of them of a pecuniary nature, in the shop, factory, business and home life; and the public was willing to pay for such a splendid commodity what was judged a fair price, even though, measured by the standards of today, it was a comparatively high price. Measured by the earlier costs of limited production and distribution, it was nothing more than a fair price. The only complaints to which the service was subjected in respect to price were the results of variation in the monthly bills, where the reasons for the variation were not understood.

It was in the earliest days that the Company recognized again as a matter of policy that the customer in making a complaint believed himself to be right, and that he was entitled to have his complaint studied and passed upon in the light of this belief on the Company's part. No complaint,

however small the amount involved, or seemingly foolish, was to be slighted or treated with other than the utmost consideration and thoroughness of examination. Every complaint was to be finally answered in writing, and with the fullest degree of fairness. It was recognized that the customer, dissatisfied with his bill or any other feature of his service, was drawn into that state of mind by some condition apparently of an undesirable nature existing in the service itself; and that when in this attitude, he offered an exceptional opportunity to make a lasting and valuable friend of the Company, through unfailing courtesy and the fullest justice, and to secure a further addition to that degree of public approval and endorsement which the Company has already stated, with the utmost frankness, it so greatly desires from every member of the great community it is privileged to serve.

In recognition of the importance of meeting customers courteously and fairly, the Company, early in its career, adopted the rule that its commercial men must not handle complaints. Partly because, if good commercial men, they were naturally sympathetic to the complaining customer, and thus as such by their manner of agreement with the customer's attitude as anything else, rather confirmed and strengthened the customer's views, whether justly founded or not. They thus led to an enhancement of the feeling of incipient dissatisfaction with the Company rather than to a lessening or the elimination of that grouch which under the Company's policy could be inevitably brought about.

In making a complaint, especially regarding bills, the customer is not always right, but he undoubtedly always believes himself right. That is human. To meet him adequately, and persuade him that the profoundest wisdom is fallible somewhere, requires not only an intimate acquaintance with the meter, and the Company's policies, but a high degree of favorable personality, in order to avoid misunderstanding

and a continued feeling of dissatisfaction. The elimination of all dissatisfaction, is naturally one of the objects of every modern utility in rendering a satisfactory service to its customers.

But to return to the subject of rates. The year 1890 saw two changes in the Company's rate schedules. The first was the substitution of the kilowatt hour for the lamp hour as billing definition, and the second the substitution of 20 cents a kilowatt hour, with discounts in bills exceeding $100 monthly for the former rate of 1.2 cent for 16-candle power lamp hour downtown, and 1.1 cent for a similar unit uptown. A further change in the year 1900 was the substitution of a schedule under which consumers having a high average of use of their installation could obtain a rate as low as 5 cents a kilowatt hour for a part of the service—for the first time putting into effect a schedule through which, with an increase in the average use, a reduction in the rate would automatically follow. It may be of interest to know that the complete schedule at that time was 20 cents a kilowatt hour for the first hourly average use of the connected installation, 15 cents for the second hour, 10 cents for the third and fourth hours, and 5 cents for all in excess of four hours' average use. As in other schedules, this price still included the supply of incandescent lamps.

While possessing the advantage of giving a lower rate to the consumer using the service under more favorable conditions, and tending to extend the use of the service, the new schedule possessed the disadvantage that each installation must be surveyed and the equipment accurately scheduled. Frequent changes in equipment and in the size of lamps made accuracy in this respect difficult, if not impossible, and led to a great deal of dissatisfaction with the method, both on the part of the Company, and on that of its customers. This method of charging, however, was continued until July, 1905, although in the meantime, during Septem-

ber of 1902, the maximum for the first hour was reduced to 15 cents a kilowatt hour, making the rate for both the first and the second hours of average daily use of the connected installation, while 10 cents was continued as the rate for the third and fourth hours' average,—but 7½ cents a kilowatt hour was introduced as a further step for the fifth and sixth hours of average use, and 5 cents was continued for all use in excess of six hours.

In 1903, recognizing the importance of affording service to the larger buildings of the city for light and power, and the effect upon general costs of increased production and distribution, and therefore, again upon the cost of serving the small customers of the Company, the wholesale schedule was adopted, which, for the first time so far as is known, introduced the block system of charging for electrical service. The maximum rate then adopted was 5 cents a kilowatt hour, for customers whose annual bills reached or exceeded $6000—in those days, very large customers. This rate excluded the installation, or the maximum demand, as factors. It recognized that the customer gave the Company all of the electrical patronage he had to give, and that any question of average use, or maximum demand, simply complicated the rate, and increased possible dissatisfaction with one part of the service or another. Therefore in such a city as New York, it was to be avoided, if it could be avoided, in fairness to the Company, as well as to the customer and the public. The principle of this rate proved so satisfactory in the Company's public relations, that it was extended for all retail service in July, 1905, when the schedule was reduced to 10 cents a kilowatt hour, without reference to average use or other installation factors.

This rate of 10 cents continued until July, 1911, when the block method of charging, which had proved so universally satisfactory to the larger customers of the Company, was adopted throughout the retail schedule in the following steps:

for the first 250 kilowatt hours of monthly consumption, 10 cents a kilowatt hour; for the next 250 kilowatt hours, 9 cents; for the next 250 kilowatt hours, 8 cents; and for the next similar block, 7 cents; the next block of 500 kilowatt hours was charged for at 6 cents, and all excess over the aggregate of these blocks of 1500 kilowatt hours of monthly consumption, 5 cents. This schedule for the first time provided an allowance to those customers who relieved the Company of the supply of incandescent lamps, who, if they guaranteed 1500 kilowatt hours of monthly consumption, were allowed to purchase their lamps independently of the service rate, to offset which they were allowed a discount of 1 cent a kilowatt hour.

A further reduction of the maximum rate, which, as will be apparent, affects the small consumer, who should always receive the highest degree of consideration by the utility, was made in 1915, when the maximum price was reduced to 8 cents a kilowatt hour, this maximum continuing until January 1, 1917, when it was reduced to 7½ cents, which continued as the maximum rate until July 1, 1917, when a further reduction of ½ cent was made, bringing the maximum to 7 cents a kilowatt hour, where it has since continued.

No attempt is made to give the rates of the different schedules in detail. They are all published and are on public file in the offices of the Public Service Commission and the offices of the Company. It is significant and gratifying that electrical service in New York City is now obtainable to the smallest consumer at approximately 25 per cent under the pre-war price of corresponding service—a condition without parallel, the writer believes, in any other industrial or commercial undertaking of the country. This percentage of reduction makes allowances for the element of coal adjustment appearing on all bills during the past year, owing to the unprecedented increase in the cost of fuel, which made im-

perative some added return resulting from the extraordinary market conditions controlling the purchase of fuel for the operation of the utility power plants. No addition was made for the enhanced cost of other supplies or labor, nor the enormous increase in taxes, State and Federal. Had it not been for the extraordinary coal situation, the Company would have succeeded in going through the entire war and post-war period without any upward swing of the rate, which during the pre-war period, as seen, underwent several successive reductions aggregating 30 per cent compared with the costs prevailing before the war.

The added cost of coal assumed was based upon the average cost of 1916 of $3.00 a ton, tidewater New York harbor; and only the excess above this figure, the so-called "out-of-pocket" added costs of coal, were superimposed. The addition itself was based upon the economic principle of the sliding scale, rising and falling with the cost of coal to the Company, and is now adding but slightly more than one-third of a cent a kilowatt hour, at which point the present cost of service is more than 25 per cent under the pre-war cost of corresponding service to the small consumer.

Thus it will be seen, from a necessarily brief outline, that the Company's record in reference to its rates, as well as its public relations generally, has been one of praiseworthy growth and development. It has aimed at all times to reach and fulfill the larger demands of the public and its expectation of fair treatment. It has endeavored to parallel what it has so successfully accomplished in the technical and scientific field, in the upbuilding and maintenance of a public service unexcelled in magnitude and comprehensiveness anywhere in the world.

CHAPTER XIII

Company Publicity, Literature and Advertising

QUOTH Hamlet: "The play's the thing wherein I'll catch the conscience of the king." This plan was shrewd enough in the days of Shakespeare, The Melancholy Dane, and the Globe Theatre near the Thames; but the times have changed, and mental illumination has as many new sources as has the physical eye, once keyed to the tallow dip and now to the Edison lamp. They who would reach the public in the early years of the sixteenth century, had beyond costly printed matter and the bell of the town crier, only the pulpit and the stage from which to deliver an important message. If its intended recipient did not frequent church, or could not read, he might perhaps be found in the play house, watching with delight the first comers of that noble race of actors who have portrayed life and character on the histrionic boards through these three hundred years. It is literally a "far cry" from the first presentation of "The Tempest" and "Julius Caesar" to the year when President Harding with a phonograph and telephone, can address a large proportion of the one hundred million of his fellow country men. It is, indeed, a "far cry" from a hundred years ago, when the news of Waterloo was twelve months reaching a remote English village, to the noon-hour when President Harding celebrates the cutting-in of a new radio station on Long Island by sending from it a "Message of Peace" to thirty of the nations of the world.

Perhaps Edison, as the father of the Motion Picture industry, has had a good deal to do with the changed aspects of the drama, but it certainly can be alleged that he gave with it new meanings to the shrewd plan of the distraught Prince. Where the appeal of the theatre was made before to

PAST AND PRESENT—THE TOWN CRIER AND THE NEWSBOY
Drawn by P Frenzeny. *Harper's Weekly*, 1882

the relatively few audiences of the "legitimate" it is now made several times daily to uncountable millions, chiefly with the help again of the incandescent lighting system that began with his work around 1877–82, and still rolls ever on, gathering up new attributes and functions just as a solid new sphere is aggregated out of impalpable star dust for men to live on. And if to the influence of the motion picture art, one of his early creations, for mankind, we add what Edison has done, since first with his phonograph he imprisoned fugitive sound for eternal reproduction, a reasonably close idea may be formed of what one master mind can do in modifying and improving for all his fellow beings their intimate realizations of light, sound, form and color.

Out of such a performance as that, Edison has quite naturally and inevitably derived a great deal of publicity and advertising. His name has been constantly in the newspapers back to the days when the London *Times* told how a little "candy chopper" out on the Canadian Grand Trunk Railroad had set up a printing press in a freight caboose and was actually publishing a newspaper from it! The great engineer Stephenson was immensely impressed by such a stunt, and told everybody "at home" of what he had seen. One of the latest to comment on the universality of Edison's genius and publicity was the Spanish novelist, Ibanez, who said of him that he was beyond doubt the best-known American of his day and generation. Wherever Ibanez went in the world, there Edison outrivaled American oil, agricultural implements, sewing machines and what not—with all his mass of real achievement and the photosphere of marvel that surrounded him. A life of him was translated not long since into the old Hindoo language, Gujerati, for the benefit of sundry scores of millions of fervent oriental admirers. And so it goes.

Now, such a man might well rest content with the unsought fame thus enjoyed, but the significant fact remains that Edison is one of the largest individual, personal ad-

vertisers in the world. Printer's ink is the thing wherewith he woos the market in which he offers a wide range of articles, only one or two of which have anything to do with any of the utilities and inventions here described. The man who hammered the first typewriter into shape, and also made the first paraffin paper to wrap candies in, has ever some new "joker" up his sleeve, and as with his electric light, no sooner is he sure that he has it, than out swarm the "ads" about it.

The New York Edison Company has taken from its creator one more "Leaf of Life," one more doctrine of practice, in its really unique publicity and advertising, since the timid directors forty years ago took a little mishap and used it as a means of talking to the public about the Edison light, perfection in itself and minimized only in value and reliability by the sheer carelessness of a young employee. Edison wanted the world to know about his light—and to use it, and the amount of money that has been spent since 1882 by Edison lighting companies the world over is such in the aggregate as to stagger belief. The New York Edison Company is today more set than ever in its propaganda as the largest purveyor in the world of electric light and power service, and a few paragraphs of this record will skim over casual items of its present methods, which sum up and continue, passionately and intensified, all the policies of the past. "There is but one Edison and Johnson is his Prophet" was the very earliest slogan, and today Johnson incarnate still shouts the New York Edison message from the rooftrees of the electrical City Magnificent. His successor of today in the flesh is Mr Arthur Williams, its general commercial manager, from whose fertile brain and wide experience have sprung many of the commercial policies which have contributed so notably to the Company's success.

Just twenty years ago, in 1902, The New York Edison Company, ever pioneer among utilities, began the publication of a handsome *Bulletin* devoted entirely to the story

of its advance in securing customers, in placing itself "At Your Service" in new and novel ways, and in picturing with word and pencil the various successive transitions of two marvelous decades of civic expansion. For the purpose of the present book, the author has recently gone over the volumes of the long series and, as an untiring student of the history of Manhattan has been impressed by the rich treasury of data that has insensibly been created by the editors of this *Bulletin*, while merely aiming to interest and instruct month by month the New York Edison patrons. All the physical changes in New York are depicted, and all the changes too in the electrical arts that have brought, through the New York Edison service, so many indispensable comforts and conveniences into the daily lives of several million people. Oddly, one of the very first long articles is an interview with Edison on electric automobiles, by a man named Romer. The very latest *Edison Monthly* Bulletin, August, 1922, is still "harping on my daughter," with facsimile of a full-page vehicle "ad" and a page article all about it. And to exemplify the infinite range and versatility of electricity, three pages are devoted to a fascinating story that tells how the New York Edison current makes the eagle scream—said bird being perched over the door of the Garfield National Bank, whence it emits an earsplitting squawk the moment a bad check is put under the nose of the cashier. This "Trouble" device is set in operation electrically by knee or foot pressure from sundry stations in the bank, whereupon an eight-horse-power motor sets going a most raucous siren, quite as unmelodious as that with which the Edison Company could awaken the echoes, during the war, as warning against aeroplane attacks. As sharp contrast, a domestic article of four pages on "Blue Monday" tells the story of the evolution of the thousands of electric washing machines on the New York Edison circuits, and shows the housewife what she has escaped from, with pictures of washday in 1582, and how

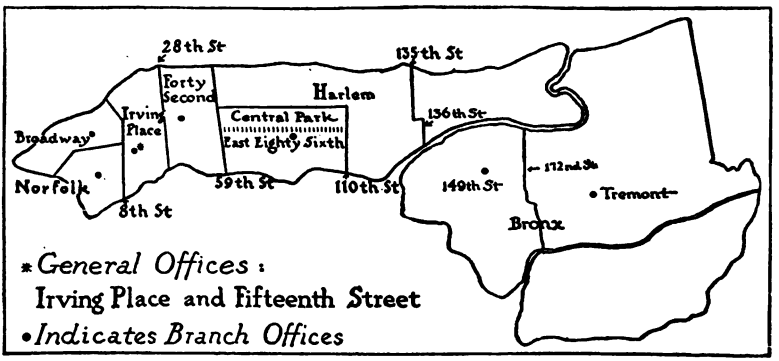
SOME OF THE RECENT ADVERTISING MATERIAL

Including a letterhead, a label, place cards, a calendar, a blotter, a price card, mailing cards, a folder and a booklet

they still do it today far from the Bowery, in the rivers of ancient India.

As a necessary counterpart of this, there is the *Edison Weekly*, a large quarto whose sole object is to promote esprit de corps among the employees of the Company just as the other is designed to cultivate friendly relationships with the customer. Perhaps the eight pages of this house organ, are more intimately illuminative of the governing motives and inner economy of the great system than anything else that can be studied. The Company is seen in action—orders of the day, outlines of campaigns, recognition of brilliant work, hints as to new opportunities, tales of the vacation, the sad and sweet happenings of life, help given by employees at a big fire, record of a Sprague motor still running after thirty-two years' service, data about the useful New York Edison Bureau of Electro-Therapeutics, lectures from the Bureau of Home Economics by a woman employee before students of the Teachers' College; items and views of tennis tournaments, bowling competitions and loving cup, and a description of how a novel application of electric heat is being made in a machine that presses tinfoil on cheese packages, so modulated as to draw the butterfats to the surface, make the tinfoil adhere, and thus prevent mold. An excellent article describes and illustrates the new type of signals for traffic on Broadway, electrically lighted from the Edison system and operated by a policeman. And last but not least, although the "Grand Old Man" hates to tear himself away from that beloved laboratory at the foot of the Orange Mountains, he ever keeps in touch, for "Mrs Thomas A Edison was a distinguished visitor to the Forty-second Street showroom last week."

Quite in a class by itself is the *Edison Directory*, published quarterly for the purpose of rendering the greatest possible assistance to those desiring to use Edison service for any purpose. It is essentially a booster for business. It

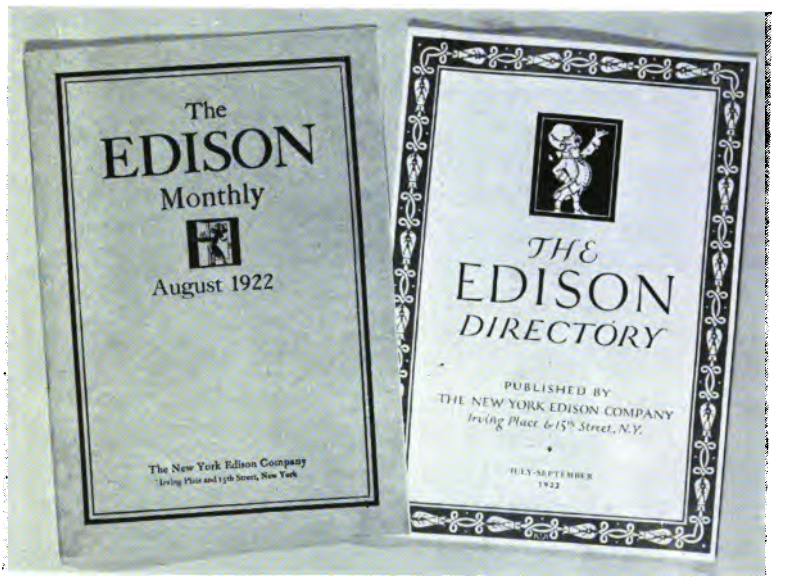


gives every manufacturer's agent, dealer or contractor an equal chance with the "prospect"—and then "The choice of the possessor of the 'free dollar' is the determining factor." There are thirty-four closely printed double-column pages of names and addresses. Forty years ago there was literally but one manufacturer to deal with for apparatus to go on New York Edison circuits. His name was Edison and he was his own agent. This Directory gives sixteen pages of manufacturers and their agents—hundreds of them. There is also a full page of automobile charging stations—some thirty-nine of them. As one recalls the Johnson-Clarke wiring school of 1882–3, it is a curious contrast to note nearly four pages of the names of licensed wiring and installation contractors who deal with the Company, intermediaries in "hooking up" the customers and their equipment with the service that comes to every door like the water supply; but after delivery there ceases any similarity to a mere jet from the faucet, and it can be addressed to the whole range of human physical needs. Most startling of all, is the twelve pages of lamp agents, arranged according to location with reference to the district offices of The New York Edison Company, according to the territorial map here inserted. A page is also given to the District Offices themselves. Although not for public use, the Company has for internal service a private telephone

directory of officials, which compares quite significantly with the first book telephone directory of New York City, issued in August, 1879—a modest manual of only forty-seven pages and eight hundred names.

Other specific literature of the Company may be noted. Each piece, each group of pamphlets, refers to some particular field of service. That book on "Kitchenette Cookery" is a 32-page collection of recipes tried out by domestic science experts of the New York Edison Bureau of Home Economics and all can be produced with a grill, ovenette, waffle iron, percolator, etc, attached to the lighting socket. Of kindred character is a little brochure on "Iceless Refrigeration," dealing with the electric refrigerator, a device soon to be as well known for cooling food as the fan motor is for cooling humans. Still another deals with the simple technique of the electric washing machine. A 32-page pamphlet sums up the cost and virtues of twenty-eight classes of domestic electric appliances; and still another discusses the "Wrong and Right Way to Use" these home adjuncts. The baby comes in for a whole series of its own; and a big colored broadsheet illustrates twenty-eight ways in which Mistress Manhattan can use her little "electric servants" from 7 am to 7 pm. Needless to say, electric signs have a group of effective booklets of most alluring appeal. One of these illustrates its arguments with the types of signs that have made the "Great White Way," better known than any other nickname of a great thoroughfare, and that "indelibly impress their messages every night on the minds of hundreds of thousands of people." Supplementary to this is a thoughtful little pocket piece "Planning for Directional Electric Signs," solely intended for busy architects, and "listing those places where interior electric signs have repeatedly found their truest expression." Going beyond this, in practical aim, is a pamphlet which ought to be in every home, office and factory, "The Economics of Good Lighting," with its discussion of

THE FIRST USE OF THE EDISON MAN IN ADVERTISING—
USED AS A BLOTTER



THE COVER DESIGNS OF TWO EDISON PERIODICALS

accidents from poor illumination, data on production and morale as affected by bad or good illuminating engineering, and then presenting a series of recommended standards of illumination for rooms, mills, factories of all kinds, halls, churches, schools, elevators, stores. All of this for well people, and the places where they congregate. For those who can be benefitted by the modern scientific application of electricity to curative purpose, there is The New York Edison Bureau of Electro-Therapeutics with its literature and demonstrations bearing on the use of such "ministering angels" as electro-blankets, pads, vibrators, violet-ray machines, instrument sterilizers, bedside lamps, bottle warmers. All these and sundry other devices bring back again in perfected form the appliances that were the philosophical toys and fancies of the good old days of static electricity—of Franklin, Nollet, Hauksbee—and now with Edison current to activate them, alleviate suffering or abolish pain.

In 1905, a distinctive and altogether delightful personality was introduced to the group of fictitious characters that have become identified with "old New York." It is the world-famous "Edison Man" of Mr F G Cooper, whose artistry has since overflowed into other fields but first became known when as a shy, modest, struggling youth he submitted his sketches of Father Knickerbocker "At Your Service." He received instant encouragement and support from the officials of the Company when they enthusiastically welcomed that charming embodiment of the courtly airs and debonaire graces of an earlier Knickerbocker day, so suggestive of amiable politeness and kindly intent, so pervaded with an atmosphere of good will and enjoyment of life in seeing other people happy. Cooper's fertile genius never showed to better advantage than when he thus put the "Edison Man" into a portrait gallery of immortals of the imagination, alongside John Bull, Columbia, Uncle Sam, Phoebe Snow, and even the Gold Dust Twins and Aunt Jemima. It suffices to mention

thus only one or two other rather shadowy trade characters to appreciate how finely Cooper has created a real human being of "sweetness and light"—and then note how, adopting that creation, The New York Edison has not only worked up the ideal through these seventeen years, but perhaps even insensibly influenced by it, has taken it as the great exemplar. A man is known by the company he keeps. Conversely, a company is known by the men it keeps,—and that courteous, lovable "Edison Man" serves to represent ten thousand others whose ambition is to be equally suave and bland in deportment, always courteously, "At Your Service."

The Edison Man has grown visibly since he was first made use of in New York Edison publicity in 1905,—and he would not be a real New Yorker if he had not annexed a charming feminine companion in the "Edison Girl." Moreover, the flexibility of the character has been dwelt upon by a leading "ad" expert, who is struck also with his ubiquity. One sees him everywhere in every method of expression—calendars, posters, broadsides, stained glass windows, blotters, price tags, cigar wrappers, memoranda blanks, daily newspaper advertising, return postal card stamps, booklets, match boxes, cut-out puzzles for the children—and in all of them, like the character in "The Mascot," he "bobs up serenely," and always comes up smiling, whatever the task or the message entrusted to his ingratiating delivery. He "gets there"—but that was ever a New York quality; and the milder attributes of a more leisurely and polished age are also born again in this personification of a public utility whose commercial success has been developed by its supreme administration of the physical resources of civilization in their latest reach—steadily improved and enhanced so that "what it does still betters what is done" and crowns each earlier achievement in the present deeds.

CHAPTER XIV

The Company Officials and Employees —Relations with the Industry—Co-operation during the Great War

TELLING in the humorous way he has of treating difficulties lightly, Mr Edison describes a visit paid to his superintendent of Pearl Street, Mr Charles E Chinnock, selected by him at an anxious moment to run the Pearl Street Station. Inquiring as to the competency of the previous incumbent, the visitor said to Chinnock, "Did Mr Blank have charge of this station?" "Yes, sir." "Did he know anything about running a station?" Chinnock ejaculated with emphatic fervor: "Does he *know* anything about running a station like this? No, siree! He doesn't even suspect anything!"

The preceding pages will, it is hoped, have given a fairly good idea of the qualities needed to manage and operate an enterprise such as the great public utility known as The New York Edison Company. Even in the days when Chinnock rose nobly to the occasion, and, while conducting the plant with interior efficiency, also put it on a sound financial basis, the demand was evident for ability of a very superior order. A glimpse at the psychology of the earlier management is given in the little discussion in the rate Chapter. In those early days, central station managers were created by the display of their native talent. They were invited to "Come up from the kitchen!" whether it be a boiler room, a stenographer's desk, a banking office, a factory floor, an oil camp, a gas works, a dry goods store. As ever, in the advance of industry and invention, a new opportunity had been presented for the differentiation of ability and function.

Very soon the expansion of the central station field and

the enormous growth of the industry led to a further differentation within itself, and the creation of organized forces into departments and bureaus, under heads of distinctive skill in the work to which they were assigned. The New York Edison Company may be taken as a good example of all this natural evolution historically, and in the constitution of its official personnel. The writer begs to be acquitted of any neglect if he does not here enter, as he would most cheerfully, upon a little "Who's Who" in the Company, for after a lifetime of acquaintance with them all and having as a journalist devoted many of his pages to their work, he could probably dispose of all of them in a "survey" without treading on toes or bringing the blush to a hardened cheek. Since that is taboo, the liberty will be taken of pointing to the Company as once a great commonwealth was apostrophized, and saying: "See, there she stands! Do you think such a great representative organism could have been created and maintained without a large measure of genius, ability, knowledge, experience, zeal and devotion on the part of each man concerned these forty years and today?"

To one man, especially, since he is not here to object, it is desired at this point to pay a personal tribute—the late Mr Anthony N Brady, for many years president of the Company. As editor of a leading electrical journal, the opportunity came frequently to the writer to meet him, and involuntarily to measure him up with other great public utility leaders or as a power in the field of electrical manufacturing. Shrewd, forceful, direct, the qualities that stood out were his soundness of judgment in large affairs, his swiftness of decision rarely wrong, his intimate knowledge of construction problems, his aversion to the limelight—and above all his desire to be fair and just. Even if given quickly, his word was his bond. He appreciated loyal service and rewarded handsomely. His stamp on American public utilities was deep and lasting and his aim was high.

OFFICIALS AND EMPLOYEES

Something has already been said in various chapters of the different departments, and of the duties of the rank and file involved in their proper functioning. An aggregation of some 9000 picked men, under able command, is concerned; and the general conditions in the field of employment and in the relations so crudely summed up in the expression "Capital and Labor," have their sociological effect here quite as fully as anywhere else in these United States. It need not be emphasized again that the foundations of the Company were laid by co-workers striving emulously with the Great Master, in as true a spirit of comradeship as that which inspired Governor Carver and his little band of Pilgrims at Plymouth. From that Pearl Street epoch to the present, it has been sought to maintain the personal intimacy and keep an "open door" policy alive between executives and workers. As was said ten years ago, when the Company celebrated its third decade: "It is, however, manifestly difficult, if not impossible to maintain the same intimate, informal relations in a large body as in a small one. But through all the enormous development of the last fifteen years, a spirit of genuine interest has existed between the executives and all members of the Company. This is perhaps due to the fact that many of its officials have won their way to their present positions from the ranks."

They are still rising from the ranks, and to no work does the management give more attention than that of keeping the upward path clear for aspiring talent. A year-book for 1921–22 devotes no fewer than fifty-four pages to the "Educational Courses and Employee Relations" of the Company. In 1911, a school, quite like that little red school house of electricity set up by Johnson, was established to provide other than technical training, attendance was compulsory, and the employees were allowed time for it during business hours. It aimed to be not only a "school of salesmanship" but a "school of acquaintance" with duties and department interrelation-

ships, and, if it may be so phrased, a "school of knowledge of oneself," anticipating much of the popular educational effort of the present hour, with a rational attempt to spot defects rather than a morbid analysis of feelings. Today, The New York Edison Company, which has done much to help corporate advance generally in this line, maintains three schools through the Association of Employees of the Company. The Technical School, now fifteen years old, dating back in reality to 1906, provides in courses of several grades, electrical instruction all the way from platform experiments to advanced laboratory work by the students themselves. The courses may not go as far or as deep, but they compare favorably with anything done in the colleges. The Commercial School, started in 1911, has broadened out into instruction not only in salesmanship, but in utility service to the public, and the history and development of electricity and the arts. Junior clerks and office boys see vistas of the higher walks in life, and learn that as citizens of no mean city they have a special chance to make good in a corporation that, for example, receives some 30,000 telephone calls a day for prompt, accurate and courteous attention not only as they come in—but in after disposal. The women of the Company find in the Commercial School two courses in Domestic Science, one in cooking and the other in sewing. The third of the educational efforts is covered by the Accounting School. As long ago as 1912–13, the first course in the Theory of Accounting was presented under the auspices of the Association of Employees, by an instructor from the School of Commerce, Accounts and Finance of New York University. A supplementary course of ten lectures was given by Company officials. This work was helpful, it grew naturally and rapidly, so that today there is a three-year course which ranges over the whole domain of accounting, finance and business economics, from double entry bookkeeping to the organization of the holding company.

So much for education. In other Company relations, the subject of industrial injuries looms large. The Company did not wait for the coming of the New York State compensation law of 1914, equitable, fair and far-reaching, but had already prior to that taken upon itself the entire burden of industrial injury and loss. Injured employees are paid full wages during the entire time of disability, besides being furnished with the best medical attention. This humanitarian practice permits of no misunderstanding on either side. It is noteworthy that while under the Workmen's Compensation Act, electric lighting is classed as a hazardous occupation, only a very small percentage of New York Edison accidents are purely electrical—ranging from 8 to 10 per cent. Last year the vast majority of the casualties might have occurred in any employment. No refinement of precaution is unknown to the various plants for protection, prevention or rehabilitation.

For all who have borne the burden and heat of the day of faithful service, the Company has in operation a Service Annuity Plan under which any employee may receive such service annuity subject to the approval of the Board of Directors if he is at least fifty years of age and has rendered satisfactory service continuously for twenty-five years. The annuity is at the rate of 2 per cent for each year of service with the Company, on the average wage for the last preceding five years. The maximum annuity, however, may not exceed 60 per cent of the average wage for the last five years.

The Association of Employees of The New York Edison Company has already been referred to in various connections. It was organized in the autumn of 1905, with social, educational and beneficial objects, and with three classes of membership—active, insurance and honorary. Active members are voters, who can hold office. Insurance members are former employees who still retain the insurance privileges. Members employed on an hourly basis are entitled to the additional benefit of the Sick Benefit Fund, established

EDISON ELECTRIC ILLUMINATING CO STAFF COUNCIL—1896

Messrs H A Campbell, Joseph Williams, Arthur Williams, H M Edwards, John W Lieb, John Van Vleck, vice-president, R R Bowker, H J Smith, Henry Stevenson, Frank Enos, Chas S Sheppard, W J Donshea

November 15, 1915. The annual dues of active and insurance members are $2.60, all of which is reserved for application to the Insurance Fund. The dues provide each person with membership in the Association and $250 of life insurance without medical examination. Additional insurance to the amount of $1000 may also be obtained without such examination, and to an unlimited amount with proper examination and proof of insurability, under favorable rates and covering the usual "Whole Life," "Twenty Payment Life" and "Endowment" policies. The Company contributes an additional $100 to the beneficiary of a deceased member who at the time of death is in its service. The Sick Benefit Fund enables any paid-by-the-hour member to receive, on payment of a small weekly sum, about 80 per cent of his weekly wage while ill, for a period not in excess of twenty-six weeks in any year. Sick benefit dues are at the rate of 2 cents for each $1.44 benefit received, one-half of which dues are paid by the member and one-half by the Company. In January, 1906, there were 50 members and in January, 1921, the number had reached 5818. The Association in connection with its educational work maintains a fully equipped laboratory. It has a Club House with library extensively used, promotes social activities such as an annual outing, amateur theatricals, smokers, lectures and a ladies' night, to which may be added the closely contested interdepartmental bowling matches and tennis tournaments. Auxiliary to such work is the Boy Scout Troop, organized in 1914, strong for all the ideals of that fine organization, for which Camp Gawtry, named in honor of Mr Lewis B Gawtry, formerly secretary of the Company, is maintained on Lake Stahahe, in the Interstate Park on the Hudson River.

Beyond all this there is a close affiliation with the industry as a whole, through the National Electric Light Association, and The New York Companies Section of that influential and representative body. The section comprises five operating

electrical utility companies within the limits of Greater New York, and The New York Edison Company supplies about three-fourths of the membership. This organization is financed partly by the employees of the companies, as personal Class B members of the National body and partly by the companies as corporate Class A members. When a member is also in membership in The New York Edison Employees Association, the Company pays one-half of his $3.00 yearly dues.

It may be fitly noted at this point that both in the Association of Edison Illuminating Companies and the National Electric Light Association, as well as in such bodies as the American Institute of Electrical Engineers, The American Society of Mechanical Engineers, The American Society of Civil Engineers, The Illuminating Engineering Society, The New York Electrical Society, and other national or local technical bodies the officers and employees of The New York Edison Company are numerously represented, frequently filling the presidency or other high positions of services, are represented on many of the Committees, and are at all times living up to the slogan "At Your Service" and evidencing active belief in Bacon's dictum that a man owes such service to his profession, while receiving in return benefit from all these professional ties and relationships.

Both in their civic and in their national relations, the officers and employees of The New York Edison Company have, it may be noted in their behalf, measured up to the requirements of good citizenship, individually or standing back of the corporation in its pledges and undertakings. A large share can readily be played in local events such as the home coming of Admiral Dewey or the Hudson-Fulton Celebration, because electric light and power are indispensable and are made available for spectacular and commemorative purposes on a scale never before attempted. An electrically illuminated city appears to be en fête even on the most

prosaic occasions, and perhaps the old town is never more beautiful than when the veil of fog and mist falls upon its vague radiant towers as the day closes, or when its wet and shining pavements reflect in gentle glow the lower constellations—golden rows of matter-of-fact street lights. But when New York really makes deliberately ready to "light up," The New York Edison Company is all there as official torch bearer at large for the whole community. Such glorified illumination comes readily to mind not only in connection with the Spanish-American War but more vividly and recently in celebrations of the Great War and the return to God's Country of the boys who went overseas to "make the World safe for Democracy."

It is with a brief account of what The New York Edison Company did in the Great War that the chronicler would close his story of forty years "At Your Service" because then the sentiment expanded beyond local horizons and expressed the loftiest patriotism. In fact, its interpretation in terms of loyalty and preparedness came long before the call to arms. It was not until 1916 that the National Defence Council was formed to meet the military, industrial and commercial needs of the hour, when the protective forces of the lighting companies of New York City had already been functioning efficiently for more than two years! They had called into existence of their own initiative a special uniformed police of 600 men to protect plants and distribution systems, and this was but the nucleus of a larger force. Valuable and vulnerable property on which the great population depends for light, heat and power, three main props of human existence, escaped damage without scar, even after the country had entered into active war. This special force co-operated fully with the Army, the Navy and the Police. Other work fell to the regular lighting staff of the Company in protective lighting, special, portable temporary lighting and spectacular lighting. In this was included particularly the safe-guarding

of bridges and river tubes, as well, incidentally, as frustrating any attempt to pocket by blowing up the nearest bridges, the Brooklyn Navy Yard in its entirety. "Flood lighting" took on a new significance. Most vital of all was such service in protecting the water supply of the City, which for Manhattan and Bronx Boroughs reaches the enormous quantity of nearly 500,000,000 gallons daily. It was of sinister import that in the winter of 1917–18 over one hundred fires daily in New York City seemed on investigation to be of incendiary origin. The one real insurance against the mighty conflagration sought as an infallible means of destroying the whole city and putting all its vast agencies out of commission, was the maintenance of the daily flow southward of a half-a-billion gallons through the northern aqueducts—Croton and Catskill. Up among the mountains where Rip Van Winkle went to sleep and galloping Ichabod Crane beat the Hessian by a length, twelve hundred guardsmen, with the aid of electric lights fed from New York Edison circuits through its allied companies operating in the localities, watched vigilantly for eighteen months against the attack of later Hessians on hundreds of miles of pipe.

One would gladly dwell on all these thrilling episodes, but there was much tedious, humdrum work, equally vital, such as that pertaining to governmental administrative functions. One officer of the Company as a dollar-a-year man became the Federal Food Administrator for Greater New York. Another was Chairman of the National Committee on Gas and Electric Service—at one time advisory to the Council of National Defence and handling fuel for the utilities, electrifying camps and cantonments, rationing energy to war industries, making tests of all kinds, supplying men at critical points and rendering expert services to government departments. The Company's President was a Special Red Cross Commissioner in Europe. Another officer planned the power plant of the immense installation at Nitro, W Va, for the pro-

duction of smokeless powder at a cost of $80,000,000, some 20,000 employees turning out 325 tons a day, being housed in a mushroom town of over 5000 buildings with streets, sewers, water and gas mains, electric light and power, etc. One stunt was the thawing out electrically in the Harlem River of a U S torpedo boat that was frozen stiff in the ways. Various members of The New York Edison Company's Engineering and Test Departments were assigned for several months, in 1917, to the solution of pressing war problems under the direction at his Orange Laboratories of Mr Edison, as Honorary Chairman of the Naval Consulting Board.

Within the Company, all was war activity through the period of stress and strain from April, 1917, until the end came with the Armistice in November, 1918. First of all may be mentioned the hearty participation by the Company and all its employees in subscribing to and helping to raise the five Liberty Loans of nearly $19,000,000,000 and in disposing of the War Savings Securities that brought the new war debt up to nearly twenty billions. What was done in the food and fuel saving campaigns was of equal magnitude and importance. The New York Edison Company co-operated actively in the work of the Government, in educating into self-denial a great well-fed population of 6,000,000 of whom roughly one-third were foreign born, coming from fifty foreign countries, mostly without any knowledge of English, and to be reached in some 1,200,000 families occupying 365,000 homes. The actual enforcement of regulation and willing acquiescence secured amongst a people of such heterogeneity was a monumental achievement. The mere fact that 584,054 New York women by pledge cards circulated through New York Edison vehicles, employees and agencies, became members of the Federal Food Board is noble testimony secured forever as to the oftchallenged patriotism of this little island on the silver Sound. But there was also participation in the organization of volunteer Engineer Regiments, the Red Cross

activities, and other philanthropies aided—such as Salvation Army, Knights of Columbus, Young Men's and Women's Christian Associations and benevolent work done for the families of those who went on naval and military service. The simple, pathetic records show that from the New York Electric Lighting Companies there enlisted or were drafted no fewer than 1551 men of whom 43 made the supreme sacrifice, dying in the cause and uniform of their country. Many were wounded, suffered loss of limb or health, or were gassed. Several were decorated for gallantry. "At Your Service" had found its noblest expression.

CHAPTER XV

The Next Decade "At Your Service" and Thereafter

THE population of New York City is growing at the rate of 50,000 new inhabitants a month. Every year the city is adding the equivalent of five Albanys to the number of those who live within its ever-expanding borders.

There lies one of the problems of The New York Edison Company in the next ten years, for there should be, even at that rate of increase, 12,000,000 to be supplied in 1932 with electric light, heat and power, and all the other new services that electricity takes over or creates.

Among the other problems that confront the Company are those of its future engineering. There is no reason to believe that the rate of progress in the mechanical and electrical arts will be any less now and hereafter than when the group of inventions to which the name of Edison is attached broke upon a dazzled world. Edison himself would be the last to accept any such conception of human destiny. Is not the one time obscure "Edison Effect"—a mere black shadow cast on the enclosing globe by the carbon filament in his very first lamps, forty years ago,—the profusely pregnant breeder at this very moment of a whole new development that ranges from effective radio transmission to the production of a novel series of heavy power apparatus, and to the latest researches into the constitution of matter?

That is one end of the scale of possibilities. At the other is the statement of a leader in the field of animal light generation that with a color distribution rather worse than that of the mercury arc, the firefly does produce a light of sufficient intensity for human use, of a quality that makes it advantageous for many kinds of work. "Its efficiency is undoubtedly

exceedingly high, since study of both its total and its radiant and luminous efficiency indicate figures of 80 per cent or better." Daily hints from Nature are prodigally at the disposal of those who come after. Thanks to the work of such men as Edison, each later age has greater resources placed at its disposal. It was not until this age that radium itself, existing through all the presence of man on earth, reached recognition and use. Evolution does not work backward in invention or science.

As for the burden that all this higher environment is alleged to have placed on the shoulders of civilization, man becoming the victim of his own inventions, the assertion is simply made here that the proposition is not true. The iron law of natural inequality may still run counter to philosophical theory and political aims, but invention does benefit everybody, removes the grounds of revolt, brings culture, happiness and comfort to ever larger numbers of people in larger degree, and will go on, as we throw off the relics of chaos, barbarism, ignorance and physical suffering.

To this Edison has, if there is any truth in the present modest record, contributed largely, vitally, nobly. Through The New York Edison Company every dweller on Manhattan is his residuary legatee. Through the universal acceptance of such boons as the Edison lamp, his system of electrical distribution, and his numerous epoch-making inventions, the world becomes fitter to live in, and mankind better able to live in it.

CHAPTER XVI

Statistical Data

Average Life of Lamps during Early Years of Edison Service

	1884	1885	1886
January	400 hours	1084 hours	1227 hours
February	523 hours	1075 hours	1091 hours
March	349 hours	1032 hours	996 hours
April	448 hours	1047 hours	998 hours
May	400 hours	838 hours	1244 hours
June	389 hours	939 hours	1423 hours
July	502 hours	1009 hours	1505 hours
August	553 hours	924 hours	1235 hours
September	727 hours	948 hours	1504 hours
October	730 hours	884 hours	1478 hours
November	914 hours	1029 hours	1623 hours
December	832 hours	1347 hours	1462 hours

From the Annual Report of the Edison Electric Illuminating Company for 1886

The Company Payroll

	Number of Employees	Total Annual Payroll
Week ending August 24, 1882	78	$71,000.80
30 years after August 24, 1912	5732	$5,167,847.88
10 years after July 1, 1922	8427	$13,299,319.28

FORTY YEARS OF EDISON SERVICE

Growth in Customers and Equivalents

Manhattan and Bronx

Year	Number of Customers	Number of Meters	50 Watt Equivalents
December 31, 1892	4,344	. . .	196,932
December 31, 1893	5,154	. . .	273,361
December 31, 1894	5,877	. . .	340,784
December 31, 1895	6,675	. . .	425,823
December 31, 1896	7,898	. . .	613,991
December 31, 1897	8,711	. . .	756,438
December 31, 1898	9,990	. . .	891,614
December 31, 1899	11,015	. . .	1,102,121
December 31, 1900	16,349	. . .	1,473,807
December 31, 1901	. .	28,036	1,928,090
December 31, 1902	. .	33,691	2,343,721
December 31, 1903	. .	40,230	2,851,463
December 31, 1904	. .	46,961	3,320,310
December 31, 1905	. .	56,572	3,878,666
December 31, 1906	. .	68,990	4,923,986
December 31, 1907	. .	80,809	5,856,166
December 31, 1908	. .	90,283	6,729,926
December 31, 1909	. .	104,449	7,422,649
December 31, 1910	. .	121,853	8,584,725
December 31, 1911	. .	144,018	9,922,562
December 31, 1912	. .	169,075	11,886,692
December 31, 1913	. .	193,658	12,212,768
December 31, 1914	. .	212,818	13,283,437
December 31, 1915	. .	232,506	14,088,169
December 31, 1916	. .	*222,838	15,055,358
December 31, 1917	. .	236,571	16,079,257
December 31, 1918	. .	245,855	16,954,478
December 31, 1919	. .	267,676	17,321,988
December 31, 1920	. .	296,165	19,049,237
December 31, 1921	. .	325,842	20,714,628
June 30, 1922	. .	343,410	21,528,563

* Due to installing master meters.

STATISTICAL DATA

Mileage of the Two-Wire System in the First District, Showing How it was Superseded by the Three-Wire System

December 31, 1889	15.24	Miles
December 31, 1890	13.16	Miles
December 31, 1891	8.81	Miles
December 31, 1892	6.37	Miles
December 31, 1893	3.2765	Miles
December 31, 1895	0.24	Miles
December 31, 1898	0.15	Miles

From Annual Reports of the Edison Electric Illuminating Company

Most Northern Point of the Edison System at Various Stages of Development

1883	Nassau Street near Park Row
1889	Fifty-ninth Street
1890	Fifty-ninth Street
1891	Sixty-sixth Street
1892	Seventy-ninth Street
1893	Seventy-ninth Street
1897	Eighty-seventh Street
1898	Ninty-fifth Street
1902	The Bronx
1912	Edison Service in practically every street of Manhattan and the Bronx

FORTY YEARS OF EDISON SERVICE

Dates of Opening Various Stations

1882	255–257 Pearl Street
1886	60 Liberty Street (annex station)
1888	Thirty-ninth Street—West
1888	Twenty-sixth Street
1890	Produce Exchange Annex
1891	Duane Street
1893	Fifty-third Street
1895	Twelfth Street
1896	Bowling Green
1898	Eighty-third Street
1898	Crosby Street
1899	Gold Street
1899	One Hundred and Twenty-first Street
1900	Vandam Street
1900	Horatio Street
1900	Eighty-fourth Street
1900	One Hundred and Twenty-third Street
1900	One Hundred and Fortieth Street
1900	Riverdale
1901	Waterside No 1
1903	Clinton Street
1903	Twenty-seventh Street—West
1904	One Hundred and Seventh Street
1906	Water Street
1906	Waterside No 2
1906	Thirty-ninth Street—East
1906	Sixtieth Street
1907	Sixteenth Street
1907	Sixty-fourth Street
1909	Fordham
1910	Gimbel Building
1910	Blackwell's Island
1910	Forty-first Street—West
1913	Twenty-sixth Street—East Hunts Point
1916	One Hundred and Third Street
1920	Sixth Street
1920	Bowery
1921	Cedar Street
1921	Seventy-third Street
1921	Inwood Avenue
1921	Greene Street

STATISTICAL DATA

The Capacity in Kilowatts of the Generating Stations for the Years 1904 to 1922:

Year Jan. 1st	Capacity Kilowatt
1904	52,100
1905	60,600
1906	70,400
1907	100,600
1908	149,300
1909	163,000
1910	173,100
1911	165,950
1912	216,950
1913	264,500
1914	246,000
1915	296,000
1916	296,000
1917	296,000
1918	296,000
1919	296,000
1920	338,000
1921	356,000
1922	356,000

The decrease in the year 1911 was due to the replacing of old machines with larger machines in Waterside No 1 and the decrease in the year 1914 was due to the replacing of small machines with larger machines in Waterside No 2.

The Edison Electric Illuminating Company and The New York Edison Company

Year	Customers	Meters Set	Number of Incandescent Lamps	Number of Arc Lamps	Heating Appliances Kilowatt	Storage Battery, etc Kilowatt	Horsepower Motors	50 Watt Equivalents
September 4, 1882	.....	.....	.....	.....	.....	.....	.....	.....
December 1, 1882	203	.....	3,144	.....	.....	.....	.....	3,144
December 1, 1883	513	.....	10,297	.....	.....	.....	.....	10,297
December 1, 1884	.....	.....	.....	.....	.....	.....	.....	.....
December 1, 1885	.....	.....	.....	.....	.....	.....	.....	.....
December 1, 1886	.....	.....	.....	.....	.....	.....	.....	.....
December 1, 1887	.....	.....	.....	.....	.....	.....	.....	.....
December 31, 1888	710	.....	16,377	.....	.....	.....	.....	16,377
December 31, 1889	1,213	.....	39,815	110	.....	.....	470	44,515
December 31, 1890	1,698	.....	64,174	254	.....	.....	697	73,684
December 31, 1891	2,875	.....	94,485	841	.....	.....	2,000	122,895
December 31, 1892	4,344	.....	142,492	1,637	.....	.....	3,807	196,932
December 31, 1893	5,154	.....	192,691	2,538	.....	.....	5,529	273,361
December 31, 1894	5,877	.....	234,494	3,014	.....	.....	7,616	340,784
December 31, 1895	6,675	.....	271,123	3,741	.....	.....	12,046	425,823
December 31, 1896	7,898	.....	309,369	4,114	.....	.....	15,953	613,991
December 31, 1897	8,711	.....	382,291	5,467	.....	.....	19,380	756,438
December 31, 1898	9,990	.....	443,074	5,660	.....	.....	24,438	891,614
December 31, 1899	11,015	.....	546,094	6,749	86	.....	32,454	1,102,121
December 31, 1900	16,349	.....	741,635	14,286	166	.....	40,719	1,473,807
December 31, 1901	.....	28,036	1,008,439	15,706	226	30.5	50,995	1,928,090
December 31, 1902	.....	33,691	1,234,043	16,481	251	1,386	62,377	2,343,721
December 31, 1903	.....	40,230	1,481,638	19,975	339	1,880	78,683	2,851,463

The Edison Electric Illuminating Company and The New York Edison Company

(Continued)

Year	Customers	Meters Set	Number of Incandescent Lamps	Number of Arc Lamps	Heating Appliances Kilowatt	Storage Battery, etc Kilowatt	Horsepower Motors	50 Watt Equivalents
December 31, 1904	.....	46,961	1,723,482	25,437	369	2,076	93,441	3,320,310
December 31, 1905	.....	56,572	2,058,060	27,627	428	2,324	109,371	3,878,666
December 31, 1906	.....	68,990	2,575,652	35,234	570	3,859	141,407	4,923,986
December 31, 1907	.....	80,809	3,057,294	40,679	921	4,669	169,588	5,856,166
December 31, 1908	.....	90,283	3,429,266	43,123	1,096	4,420	203,962	6,729,926
December 31, 1909	.....	104,449	3,813,889	40,985	1,230	5,486	224,391	7,422,649
December 31, 1910	.....	121,853	4,342,933	40,410	1,589	6,571	263,529	8,584,725
December 31, 1911	.....	144,018	4,912,428	39,329	2,283	9,024	309,187	9,922,562
December 31, 1912	.....	169,075	5,555,854	41,428	2,805	12,983	392,704	11,886,692
December 31, 1913	136,180	193,658	5,722,849	37,892	3,556	13,288	399,243	12,212,768
December 31, 1914	144,607	212,818	6,163,213	37,215	4,653	14,434	433,230	13,283,437
December 31, 1915	164,863	232,506	6,462,570	34,089	5,863	14,597	459,922	14,088,169
December 31, 1916	191,305	*222,838	6,944,044	22,290	7,615	16,431	487,698	15,055,358
December 31, 1917	212,326	236,571	7,441,690	14,433	9,234	19,027	519,663	16,079,257
December 31, 1918	215,574	245,855	7,701,028	14,080	10,050	22,670	548,707	16,954,478
December 31, 1919	237,896	267,676	7,737,180	13,261	10,774	24,685	568,810	17,321,988
December 31, 1920	271,990	296,165	8,471,673	13,363	11,780	26,342	627,509	19,049,237
December 31, 1921	296,560	325,842	9,051,180	12,780	12,784	30,040	687,871	20,714,628
June 30, 1922	313,521	343,410	9,337,144	12,882	14,960	30,937	716,274	21,528,563

* Due to installing master meters.

FORTY YEARS OF EDISON SERVICE

Mileage, by Years, of the Distribution and Transmission Systems of The New York Edison Company

Existing Dec. 31	Distribution System		Transmission System	Total Miles	Increase
	Mains	Feeders			
1881 . . .	No Record	No Record	.....	No Record	.....
1882 . . .	9.50	4.00	.....	13.50	.....
1883 . . .	No Record	No Record	.....	No Record	.....
1884 . . .	No Record	No Record	.....	No Record	.....
1885 . . .	No Record	No Record	.....	No Record	.....
1886 . . .	No Record	No Record	.....	No Record	.....
1887 . . .	29.45	20.56	.....	50.01 (?)	36.51 (?)
1888 . . .	32.29	21.93	.....	54.22 (?)	4.21 (?)
1889 . . .	41.82	25.60	.....	67.42	13.20 (?)
1890 . . .	71.97	38.69	.....	110.66	43.24
1891 . . .	94.56	46.87	.....	141.43	30.77
1892 . . .	114.25	58.23	.....	172.48	31.05
1893 . . .	122.78	64.64	.....	187.42	14.94
1894 . . .	126.42	65.41	.....	191.83	4.41
1895 . . .	134.16	68.76	.....	202.92	11.09
1896 . . .	138.66	70.67	.....	209.33	6.41
1897 . . .	144.64	77.15	.....	221.79	12.46
1898 . . .	156.30	80.16	3.26	239.72	17.93
1899 . . .	179.38	85.00	38.34	302.72	63.00
1900 . . .	225.64	98.90	49.92	374.46	71.74
1901 . . .	238.60	108.49	72.88	419.97	45.51
1902 . . .	278.46	124.15	84.63	487.24	67.27
1903 . . .	337.85	314.15	116.66	768.66	281.42
1904 . . .	384.97	344.72	144.76	874.45	105.79
1905 . . .	436.43	398.32	168.39	1003.14	128.69
1906 . . .	521.70	455.32	198.31	1175.33	172.19
1907 . . .	557.05	492.40	219.87	1269.32	93.99
1908 . . .	591.58	530.95	246.22	1368.75	99.43
1909 . . .	644.62	592.87	294.12	1531.61	162.86
1910 . . .	702.84	695.85	343.69	1742.38	210.77
1911 . . .	738.55	778.88	385.45	1902.88	160.50
1912 . . .	792.68	874.27	436.47	2103.42	200.54
1913 . . .	850.27	972.89	465.18	2288.34	184.92
1914 . . .	880.25	995.13	467.34	2342.72	54.38
1915 . . .	947.35	1126.38	449.98	2523.71	180.99
1916 . . .	1001.55	1158.72	442.27	2602.54	78.83
1917 . . .	1023.77	1167.66	433.42	2624.85	22.31
1918 . . .	1032.35	1189.88	434.99	2657.22	32.37
1919 . . .	1050.72	1221.43	432.61	2704.76	47.54
1920 . . .	1081.92	1409.47	490.99	2982.38	277.62
1921 . . .	1123.28	1467.92	655.57	3246.77	264.39

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